EPA

1993 Nonmethane Organic Compounds And Speciated Nonmethane Organic Compounds Monitoring Program

Office of Air Quality

Clean   Air

OAQPS

Planning and Standards

1993 NONMETHANE ORGANIC COMPOUNDS AND SPECIATED NONMETHANE ORGANIC COMPOUNDS MONITORING PROGRAM

FINAL REPORT

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January 7, 1994

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1.0 BACKGROUND AND SUMMARY

In certain areas of the country where the National Ambient Air Quality Standard (NAAQS) for ozone is being exceeded, additional measurements of ambient nonmethane organic compounds (NMOC) are needed to assist the affected states in developing revised ozone control strategies. Because of previous difficulty in obtaining accurate NMOC measurements, the United States Environmental Protection Agency (EPA) has provided monitoring and analytical assistance to these states through Radian Corporation. This assistance began in 1984 and continues through the 1993 NMOC monitoring program.

Between 7 June and 30 September 1993, Radian analyzed 1027 ambient air samples collected in SUMMA® polished stainless steel canisters at 13 different sites. The primary analysis for each sample was either for total NMOC or speciated NMOC (SNMOC).

The NMOC analyses were performed in accordance with the cryogenic preconcentration, direct flame ionization detection (PDFID) methodology described in compendium Method TO-12.[1] Based on the 1984 through 1992 studies[2,3,4,5,6,7,8,9,10,11], the method was shown to be precise, accurate, and cost effective relative to the capillary column gas chromatographic, flame ionization detection (GC/FID) methodology. The 1993 study continued to confirmed these findings and supported the conclusion that the PDFID method is the method of choice to measure total NMOC concentration in ambient air.

In 1987, a gas chromatographic multiple detector (GC/MD) method to determine the concentration of 38 selected toxic organic compounds in ambient air was developed and evaluated for use on EPA's national ambient air toxics programs. In 1993, air toxic analyses were performed in addition to the NMOC or SNMOC determinations at 7 of the 14 sites. Air toxics monitoring was also a component of the 1987 through the 1992 programs.

Beginning with the 1989 monitoring season, selected carbonyls were measured and reported. In 1989, 3-hour samples were collected and analyzed for selected carbonyls -- formaldehyde, acetaldehyde, and acetone. In the 1990 monitoring season, ozone scrubbers were added to the sampling assemblies to scavenge any ozone present in the ambient air sampled, prior to its being drawn through the 2,4-dinitrophenylhydrazine (DNPH) cartridges. In the 1993 monitoring season, Radian Corporation prepared the DNPH cartridges, supervised the ambient air sampling, and performed the analyses. During the 1993 program, ten 3-hour carbonyl samples were collected from 6:00 a.m. to 9:00 a.m. at two sites and analyzed for 14 carbonyls -- formaldehyde, acetaldehyde, acrolein, acetone, propionaldehyde, crotonaldehyde, butyr/isobutyraldehyde, benzaldehyde, isovaleraldehyde, valeraldehyde, tolualdehyde, hexanaldehyde, and 2,5-dimethylbenzaldehyde.

Beginning in 1991 and continuing through 1993, SNMOC concentrations were measured at several sites. Seventy-eight hydrocarbons are speciated and quantitated in this analysis. Each sample is cryogenically preconcentrated then transferred through two gas chromatographic columns to separate flame ionization detectors (FIDs). One column separates the C_2 and C_3 hydrocarbons (ethane, ethene, acetylene, propylene and propane). The other column separates the remaining 73 target hydrocarbons. Chlorinated and oxygenated species in the ambient air are not identified in the SNMOC procedure.

The final report for the 1993 NMOC monitoring program is included in Sections 1 through 13 of this report. Sections 2 through 5 report the data, procedures, and assessment of the NMOC portion of the monitoring program. Sections 6 and 7 report the data, procedures, and assessment of the 3-hour air toxics portion of the monitoring program. Section 8 reports the 3-hour carbonyl portion of the monitoring program. Sections 9 through 11 report the SNMOC portion of the monitoring program. Section 12 lists recommendations and Section 13 lists references.

The sampling sites for the 1993 NMOC monitoring program are listed in Appendix A. Appendix A also gives the EPA Regions for each site, the Radian site code, the Aerometric Information Retrieval System (AIRS) site code and site information, and indicates the base program (NMOC or SNMOC) it participated in, whether or not 3-hour air toxics analyses or SNMOC analyses were performed on selected ambient air samples from the site and whether or not carbonyl samples were collected and analyzed.

Appendix B contains the detailed procedures on the PDFID method. Appendix C lists the 1993 NMOC analytical results. Appendix D lists the 1993 NMOC and SNMOC invalid and missing samples information. Appendix E gives PDFID integrator programming instructions. Appendix F gives 1993 NMOC daily calibration data. Appendix G gives 1993 NMOC in-house quality control samples, and Appendix H gives multiple detector speciated 3-hour site data summaries. Appendix I.contains the external audit results for the NMOC, 3-hour toxics, and SNMOC programs. The SNMOC analytical method is described in Appendix J. Appendix K lists the 1993 SNMOC analytical results and can be obtained from Neil Berg, U.S. EPA.

1.1   NMOC Monitoring Program

1.1.1   Introduction and Data Summary

Detailed information on the 1993 program and the sampling schedule is given in the 1993 NMOC quality assurance project plan (QAPP).[2] For the five sites in the 1993 NMOC monitoring program, sampling occurred from 6:00 a.m. to 9:00 a.m. local time, Monday through Friday, from 7 June through 30 September 1993. Site codes for the 1993 NMOC monitoring program are listed in Appendix A. Table 1-1 gives details of the sample completeness results. Completeness, which ratios the number of valid samples to the number of scheduled samples, averaged 94.5% in 1993 compared to 90.7% in 1992, 94.1% in 1991, 95.8% in 1990, 95.5% in 1989, 93.4% in 1988, 95.0% in 1987, 96.8% in 1986, 95.8% in 1985, and 90.6% in 1984. Percent completeness for 1993

Table 1-1

1993 NMOC Completeness Results

Site Location	Radius Site Code	Scheduled Sampling Days	Total Scheduled Duplicate Samples	Total Scheduled Canister Analyses	Total Valid Duplicate Samples	Total Valid Samples	Percent Complete
Long Island, NY	LINY	82	8	90	9	89	98.89
Newark, NJ	NWNJ	82	8	90	8	90	100.0
Plainfield, NJ	PLNJ	81	8	89	7	80	89.89
Bristol, PA	P1PA	42	4	46	2	39	84.78
Harrisburg, PA	P2PA	42	4	46	2	43	93.48
Overall		329	32	361	28	341	94.46

ranged from 84.8 at Bristol, PA (P1PA), to 100.0 for Newark, NJ (NWNJ). Statistics for the NMOC concentrations in parts per million carbon (ppmC) by volume are listed in Table 1-2. This table also includes all duplicate sample concentration statistics.

1.1.2 Calibration

Each PDFID analysis channel was calibrated using propane standards referenced to the propane National Institute of Science and Technology (NIST) Certified Reference Material (CRM) No. 1666B. Daily, before instrument zero and calibration checks were performed, the analytical systems were purged with cleaned, dried air that had been humidified. Zero readings were determined with cleaned, dried air. Daily percent drift of the calibration factor ranged from -9.6% to +3.3 percent. The absolute value of the percent drift of the daily calibration factors ranged from 0.0 to +9.6 percent.

1.1.3 NMOC Precision

Analytical precision was determined by repeated analyses of 24 site samples. Percent differences between the second and the first analysis averaged -9.76 percent. The average of the absolute values of the percent difference was 22.54% with a standard deviation of 26.9 ppmC. The analytical precision includes the variability between Radian analytical measurement channels and within Radian analytical measurement channels. The data quality objective for the percent difference as published in the QAPP[2] was ±15%, based on previous NMOC program experience[3,4,5,6,7,8,9,10,11] with this measurement.

Overall precision, including sampling and analysis variability, was determined by analysis of 28 site sample pairs, simultaneously collected in two canisters from a common sampling system (a total of 56 canister samples). Percent difference for Radian's analyses of the duplicates averaged +0.479 percent. The average absolute percent difference was 12.6% with a standard deviation of 11.4 ppmC. The data quality objectives for this measurement was ±20%, based on previous experience.[3,4,5,6,7,8,9,10,11]

Table 1-2

NMOC Overall Statistics, By Site

Site	Cases	Concentration, ppmC							W^a
		Minimum	Maximum	Median	Mean	Standard Deviation	Skewness	Kurtosis	
LINY	80	0.060	0.996	0.225	0.283	0.180	1.942	4.280	0.806
NWMJ	82	0.090	1.446	0.368	0.402	0.199	1.953	8.138	0.887
PLNJ	73	0.069	1.754	0.368	0.442	0.301	1.556	3.949	0.884
P1PA	37	0.085	5.749	0.285	0.547	0.923	5.249	29.935	0.409
P2PA	41	0.059	4.076	0.259	0.445	0.649	4.689	25.408	0.486
Overall	313	0.059	5.749	0.298	0.404	0.445	7.644	80.607	0.511

[a]Shapiro-Wilh statistic to test for normality of data.

1.1.4 Accuracy

Because the NMOC measurements encompass a range of mixtures of organic compounds whose individual concentrations are unknown, it was not possible to define absolute accuracy. Instead, accuracy was determined relative to propane standards with internal and external audit samples.

Accuracy was monitored internally throughout the program by the use of in-house propane standards. Periodically, an in-house propane quality control (QC) sample was prepared with a flow dilution apparatus and analyzed by the PDFID method. The propane used to prepare the in-house QC standards was referenced to propane NIST CRM, No. 1666B.

Figures 1-1 and 1-2 show the in-house QC results for Radian Channels C and D. Measured propane values are plotted against calculated propane standard concentration values. Table 1-3 shows the linear regression parameters for the Radian in-house QC data. The regression used the propane concentration calculated from the blending operation as the independent variable and concentration determined by each Radian analytical measurement channel as the dependent variable. The concentration range of the in-house quality control samples was 0.800 to 1.326 ppmC. Table 1-3 indicates excellent QC for each channel. As expected, the intercepts are all near zero, and the slopes and coefficients of correlation are all near 1.0.

External propane audit samples were provided by the EPA through their quality assurance (QA) contractor. The propane samples were referenced to propane NIST CRM 1667B or 1665B. The audit samples were given Radian ID Numbers upon receipt. The average percent bias for the Radian channels was +4.1%, ranging from +1.8 to +8.5 percent. Table 1-4 shows the external audit results.

In-house Propane QC Results
Channel C
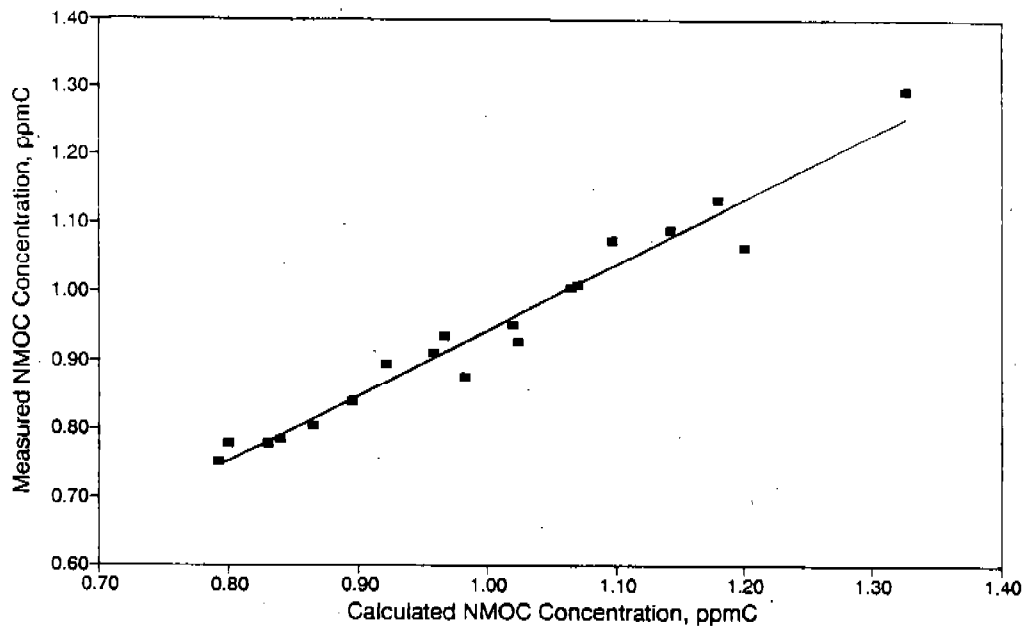
Figure 1-1. In-house Quality Control Results, Channel C

In-house Propane QC Results
Channel D
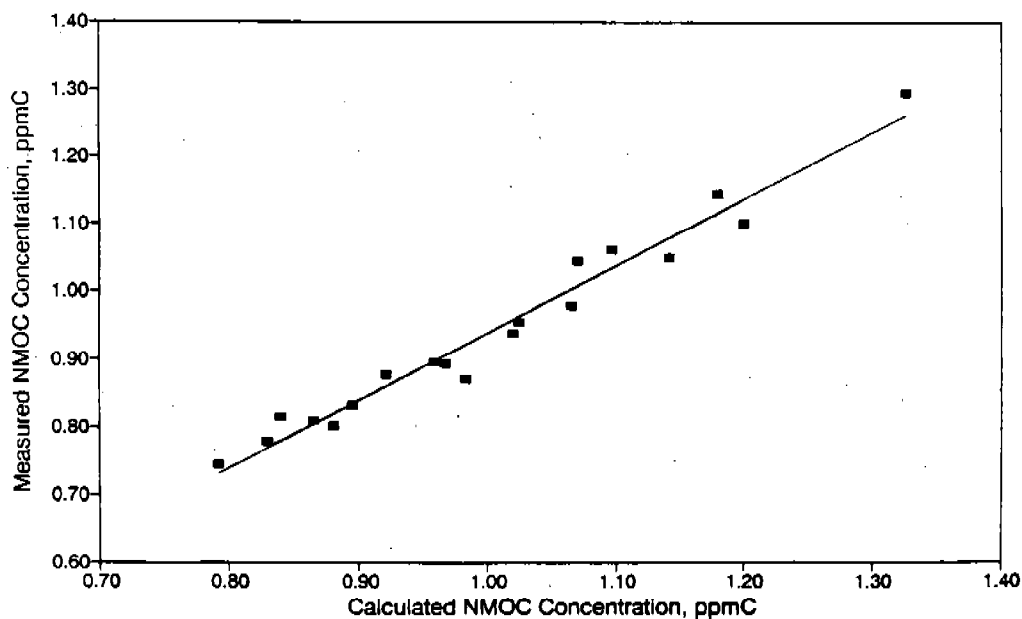
Figure 1-2. In-house Quality Control Results, Channel D

Table 1-3

Linear Regression Parameters for In-House Quality Control Data

Radian Channel[a]	Cases	Intercept	Slope	Coefficient of Correlation
C	19	-0.014	0.958	0.980
D	19	-0.051	0.989	0.984

[a]Due to the limited number of data for Channels A and B, regressions were not possible.

Table 1-4

NMOC External Audit Sample Results

ID Number	Concentration, ppmC				
		Analysis			
	Theoretical	Radian A	Radian B	Radian C	Radian D
1863	1.12	1.180	1.140	1.160	1.160
1864	0.66	0.685	0.716	0.690	0.673

1.1.5 Other Quality Assurance Measurements

Canister cleanup results showed that there was little carryover of NMOC from one sample to the next, using the canister cleanup apparatus and procedure developed for this study. In over 150 separate determinations, percent cleanup averaged 98.76 percent. Cleanliness was defined in terms of the percent of the NMOC concentration that was removed from each canister considered during the cleanup procedure.

Ten percent of the NMOC data base was validated by checking data transcriptions from original data sheets to the computerized data for 36 entries per sample. The errors found equal a data base error rate of 0.007 percent. All identified errors were corrected.

1.2 Three-Hour Air Toxics Monitoring Program

At seven sites, (NWNJ, PLNJ, B1AL, B2AL, B3AL, P1PA, and P2PA) 3-hour NMOC samples were analyzed by a GC/MD analytical system for 38 air toxic target compounds. After NMOC or SNMOC analysis, the sample canisters were bled to atmospheric pressure, allowed to equilibrate for at least 18 hours, and then analyzed by GC/MD. Duplicate samples were collected at the sites and analyzed individually by GC/MD. Replicate analyses were performed on one duplicate sample per site. A total of 70 GC/MD analyses were performed, including the analysis of duplicate samples and the replicate analyses. These data summaries are presented in Appendix H.

1.2.1 Overall Data Summary

Twenty-two target compounds were identified in the 70 analyses. Chloroform, 1,1,1-trichloroethane, benzene, carbon tetrachloride, toluene, tetrachloroethylene, and m/p-xylene/bromoform were identified in every sample. Concentrations of the target compounds identified ranged from 0.01 parts per billion by volume (ppbv) for tetrachloroethylene to 15.18 ppbv for toluene. The overall average concentration of the target compounds identified was 0.67 ppbv, averaged over all sites and target compounds.

The air toxics data are tabulated in Section 7. Results presented include numbers of cases identified, minima, maxima, and means for all target compounds.

1.2.2 Individual Site Results

Overall site total concentrations for the target compounds averaged 8.45 ppbv for B1AL, 2.99 ppbv for B2AL, 3.89 ppbv for B3AL, 15.88 ppbv for NWNJ, 10.92 ppbv for P1PA, 7.39 ppbv for P2PA, and 14.50 ppbv for PLNJ. The air toxic data are presented in Section 7.

1.2.3 Gas Chromatography/Mass Spectrometry (GC/MS) Confirmation Results

Confirmation of compounds identified was based on seven GC/MS analyses of the 3-hour air toxics samples, one from each site location. The GC/MS analyses confirmed 93.19% of the GC/MD identifications. The results are summarized in Table 1-5. Comparisons labeled "negative GC/MD-positive GC/MS" refer to specific samples in which a compound was not identified by GC/MD but positively identified by GC/MS analysis. Comparisons labeled "positive GC/MD-negative GC/MS" indicate specific samples in which a compound was positively identified by GC/MD but not identified by GC/MS analysis. Because GC/MD is more sensitive than GC/MS, this last comparison is of limited value. There were 47 cases where the GC/MD identified a compound at a concentration below the detection limit of the GC/MS.

1.2.4 Precision

Sampling and analytical precision of 3-hour air toxics samples was estimated by analyzing duplicate samples. In terms of overall average absolute percent difference, the sampling and analysis precision was 19.21 percent.

Table 1-5

Compound Identification Confirmation

GC/MD versus GC/MS Comparison[a]	Cases	Percentage
Positive GC/MD - Positive GC/MS	26	13.61
Positive GC/MD - Negative GC/MS	7	3.67
Negative GC/MD - Positive GC/MS	6	3.14
Negative GC/MD - Negative GC/MS	152	79.58
Total	191	100.00

Note: Total compound identification confirmation = 13.61% + 79.58% = 93.19%

[a]There were 47 cases where the GC/MD identified a compound at a concentration below the detection limit of the GC/MS.

Analytical precision was estimated based on the results of one repeated analysis from one of the duplicate sample canisters from each site. The analytical precision measured by the overall average absolute percent difference was 20.80 percent. Both the sampling and analytical precision results are excellent in view of the low concentration range found in this study.

Both the duplicate sample and repeated analyses results are discussed in Section 7.6.

1.2.5 External Audit

In the past years, the external audit for the 3-hour air toxics compounds was conducted in conjunction with the Urban Air Toxics Program (UATMP). Because the UATMP was not being conducted by Radian during the 1993 NMOC program, an external audit sample from the SNMOC program was used as the external sample for the 3-hour air toxics program.

The external audit sample contained 27 compounds, three of which were target compounds for the 3-hour air toxic analyses. For these three compounds, percent differences range from -59.1% (for ethylbenzene) to +46.7% (for o-xylene/ 1,1,2,2-tetrachloroethane) with an average of -4.9 percent.

1.3   Carbonyl

Carbonyl samples were collected at two sites (NWNJ and PLNJ), for the 1993 monitoring season. Three-hour samples were taken from 6:00 a.m. to 9:00 a.m., local time, simultaneously with the NMOC canister samples at the two sites. Samples were collected in duplicate from July through September 1993. The carbonyl sampler has its own inlet manifold, capillary, critical orifice and separate Metal-Bellows® pump. The inlet manifold leads into an ozone scrubber and then splits into duplicate DNPH-coated parallel cartridges.

Carbonyl concentrations ranged from 0.04 ppbv for butyr/isobutyraldehyde at NWNJ to 42.02 ppbv for formaldehyde at PLNJ. Of the 16 targeted carbonyl analytes, 2,5-dimethylbenzaldehyde, isovaleraldehyde, and tolualdehyde were not detected in any of the samples.

1.4   SNMOC

1.4.1   Introduction and Data Summary

Eight sites participated in the 1993 SNMOC monitoring program. Samples were collected from 6:00 a.m. to 9:00 a.m. local time, Monday through Friday from 7 June through 30 September 1993. Five sites that participated in the NMOC monitoring program also had SNMOC analysis performed on ten randomly selected samples. Site codes are listed in Appendix A. Tables 1-6 and 1-7 give the details of the sample completeness results for the program and option sites, respectively. Table 1-8 lists the 78 target compounds for the SNMOC program.

1.4.2   Calibration

Certified standards from Scott® Speciality Gases were used to prepare analytical calibration standards. Gas-tight syringes were used to inject aliquots of the certified standard into cleaned, evacuated SUMMA® canisters. The canisters were then filled to ambient pressure with cleaned, humidified air using a standards preparation flow dilution system. The canisters were then pressurized with nitrogen to approximately 25 psig using a precision canister dilution system.

The analytical systems were calibrated monthly by analyzing three hydrocarbon standards and a system blank of cleaned, humidified air. The calibration was considered valid if the coefficient of correlation of the four points was at least 0.995. A least squares linear regression calculation was performed for the data from each detector. The resulting slopes were used as the benzene response factor for the primary

Table 1-6

Samples Analyzed for 1993 SNMOC Program Sites

Site	Total Duplicate Samples	Total Replicate Analyses	Total Single Samples	Total Valid Sampling Events	Total Valid Samples	Total Analyses Reported
B1AL	16	8	74	82	90	98
B2AL	14	8	76	83	90	98
B3AL	16	12	58	66	74	86
BMTX	18	10	69	78	87	97
DLTX	16	8	74	82	90	98
EPTX	16	8	71	79	87	95
FWTX	16	8	72	80	88	96
JUMX	14	8	66	73	80	88
Total	126	70	560	623	686	756

Table 1-7

Samples Analyzed for 1993 SNMOC Option Sites

Site	Total Duplicate Samples	Total Replicate analyses	Total Single Samples	Total Valid Samples	Total Analyses Reported
L1NY	2	1	7	9	10
NWNJ	2	1	7	9	10
PLNJ	2	1	7	9	10
P1PA	2	1	7	9	10
P2PA	2	1	8	10	11
Total	10	5	36	46	51

Table 1-8

1993 SNMOC Target Compounds

Compound	CAS Number	AIRS Parameter Code
Ethylene	74-86-1	43203
Acetylene	74-86-2	43206
Ethane	74-84-0	43202
Propyne	77-99-7	43144
Isobutane	75-28-5	43214
1-Butene	106-98-9	43280
Isobutene	115-11-7	43270
Propylene	115-07-1	43205
1,3-Butadiene	106-99-0	43218
n-Butane	106-97-8	43212
Propane	74-98-6	43204
t-2-Butene	624-64-6	43216
c-2-Butene	590-18-1	43217
3-Methyl-1-butene	563-45-1	43282
Isopentane	78-78-4	43221
1-Pentene	109-67-1	43224
2-Methyl-1-butene	563-46-2	43225
n-Pentane	109-66-0	43220
Isoprene	78-79-5	43243
t-2-Pentene	646-04-8	43226
c-2-Pentene	627-20-3	43227
2-Methyl-2-butene	513-35-9	43228
2,2-Dimethylbutane	75-83-2	43244
Cyclopentene	142-29-0	43283
4-Methyl-1-pentene	691-37-2	43234
Cyclopentane	287-92-3	43242
2,3-Dimethylbutane	79-29-8	43284
2-Methylpentane	107-83-5	43285

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Table 1-8, continued

Compound	CAS Number	AIRS Parameter Code
3-Methylpentane	96-14-0	43230
2-Methyl-1-pentene	763-29-1	43246
1-Hexene	592-41-6	43245
2-Ethyl-1-butene	760-21-4	43236
n-Hexane	110-54-3	43231
t-2-Hexene	4050-47-7	43289
c-2-Hexene	7688-21-3	43290
Methylcyclopentane	96-37-7	43262
2,4-Dimethylpentane	108-08-7	43247
Benzene	71-43-2	45201
Cyclohexane	110-82-7	43248
2,3-Dimethylpentane	565-59-3	43291
2-Methylhexane	591-76-4	43263
3-Methylhexane	589-34-4	43249
2,2,4-Trimethylpentane	540-84-1	43250
n-Heptane	142-82-5	43232
Methylcyclohexane	108-87-2	43261
1-Heptene	592-76-7	43328
2,2,3-Trimethylpentane	564-02-3	43292
2,3,4-Trimethylpentane	565-75-3	43252
Toluene	108-88-3	45202
2-Methylheptane	592-27-8	43960
3-Methylheptane	589-81-1	43253
1-Octene	111-66-0	43145
n-Octane	111-65-9	43233
Ethylbenzene	100-41-4	45203
p-Xylene + m-Xylene	NA	45109
Styrene	100-42-5	45220

Table 1-8, continued

Compound	CAS Number	AIRS Parameter Code
o-Xylene	95-47-6	45204
1-Nonene	124-11-8	43279
n-Nonane	111-84-2	43235
Isopropylbenzene	98-82-8	45210
a-Pinene	7785-70-8	43256
n-Propylbenzene	103-65-1	45209
m-Ethyltoluene	620-14-4	45212
p-Ethyltoluene	622-96-8	45228
1,3,5-Trimethylbenzene	108-67-8	45207
o-Ethyltoluene	611-14-3	45211
b-Pinene	127-91-3	43257
1-Decene	872-05-9	43298
1,2,4-Trimethylbenzene	95-63-6	45208
n-Decane	124-18-5	43238
1,2,3-Trimethylbenzene	526-73-8	45225
p-Diethylbenzene	105-05-5	45219
1-Undecene	821-95-4	45299
n-Undecane	1120-21-4	43241
1-Dodecene	112-41-4	43330
n-Dodecane	112-40-3	43141
1-Tridecene	2437-56-1	43142
n-Tridecane	629-59-5	43143

column/detector and the propane response factor for the secondary column/detector. Table 1-9 summarizes the monthly calibration information.

Prior to sample analysis, a QC standard was analyzed to ensure the validity of the current monthly response factors. Benzene and propane concentration biases of no more than 30% were considered acceptable. For the 1993 SNMOC program, the 30% criteria was met on the first standard analysis for every sample analysis day.

Following the analysis of the QC standard, a sample of cleaned humidified air was analyzed to assess the presence of any potential contamination.

1.4.3 SNMOC Precision

Analytical precision was determined by the repeated analysis of 70 samples. These samples were a single canister of a duplicate collection. For those concentrations above the detection limit, the average concentration ranged from 0.65 ppbC (for 1-tridecene) to 30.10 ppbC (for propane).

Overall precision, including sampling and analysis variability, was determined by analysis of 62 duplicate site sample pairs, simultaneously collected in two canisters from a common sampling system (a total of 124 canister samples). Average concentrations ranged from 0.78 ppbC for c-2-hexane and 1-heptene to 28.84 ppbC for isopentane.

1.4.4 Accuracy

Two external audit samples were provided by the EPA through their QA contractor. Percent bias ranged from -20.4% to +16.1%, averaging -7.6 percent.

Table 1-9

Summary of Monthly Benzene and Propane Calibration Curves

Calibration Date	Column A		Column B	
	Correlation Coeffecient	Benzene Response Factor (AC/n1-C)	Correlation Coeffecient	Propane Response Factor (AC/n1-C)
Manual Interface System				
05/18/93	1.0000	2169.0	1.0000	1582.9
06/21/93	1.0000	2234.8	1.0000	1644.9
07/21/93	1.0000	2324.2	1.0000	1691.2
08/23/93	0.9995	2263.3	0.9995	1616.1
09/23/93	1.0000	2104.5	0.9998	1625.2
Automated Interface System				
06/03/93	1.0000	1624.6	1.0000	1623.8
07/02/93	1.0000	1507.7	0.9998	1395.4
08/02/93	1.0000	1613.8	1.0000	1548.3
09/02/93	1.0000	1557.0	1.0000	1473.0
10/04/93	1.0000	1575.8	0.9999	1600.6

2.0 NMOC DATA SUMMARY

The data summary for the 1993 NMOC monitoring program conducted during June, July, August, and September is presented in this section. Daily NMOC concentrations and other pertinent monitoring data are given by site in Appendix C. The data presented in this section summarize the NMOC concentrations measured for samples collected at five sites throughout the continental United States. Sites were selected in urban and/or industrial locations and they are described in Appendix A along with the site codes used throughout the report to identify the sites. Samples were collected in 6-liter (L) stainless steel canisters by local site operators trained on-site by Radian Corporation personnel. The sampling procedure was described in detailed written instructions and provided to the site operators. The sampling procedure instructions appear in Section 3.1.2. Analytical measurements of the samples collected were made in the Radian Corporation Research Triangle Park (RTP) laboratory according to the PDFID Method TO-12[1]. The complete PDFID methodology is presented in Appendix B.

The concentration of oxides of nitrogen (NO_x), site temperature, barometric pressure, wind direction, and weather conditions were provided on the field sampling forms by site personnel at the time of sampling. These data were recorded in the 1993 NMOC data base, but are not presented in this report because they were not measured by Radian equipment or personnel, nor were the data subjected to project QA procedures.

Table 2-1 lists the NMOC monitoring program completeness results by site code. The scheduling of sample days and the scheduling of duplicate analyses is given in the QAPP[2]. For the 1993 NMOC sites, completeness was 94.5 percent. A complete listing of invalid samples and the reasons for the invalidation are given in Appendix D.

Table 2-1

1993 NMOC Completeness Results

Site Location	Radian Site Code	Scheduled Sampling Days	Total Scheduled Duplicate Samples	Total Scheduled Canister Analyses	Total Valid Duplicate Samples	Total Valid Samples	Percent Complete
Long Island, NY	LINY	82	8	90	9	89	98.89
Newark, NJ	NWNJ	82	8	90	8	90	100.0
Plainfield, NJ	PLNJ	81	8	89	7	80	89.89
Bristol, PA	P1PA	42	4	46	2	39	84.78
Harrisburg, PA	P2PA	42	4	46	2	43	93.48
Overall		329	32	361	28	341	94.46

Completeness was defined as the percentage of samples, scheduled in the QAPP[2], that were collected and analyzed as valid samples, beginning with the first valid sample and ending with the last scheduled sample.

Overall completeness figures for the 1993 NMOC program was 94.5 percent. This compares with 90.7% in 1992, 94.1% in 1991, 95.8% in 1990, 95.5% in 1989, 93.4% in 1988, 95.0% in 1987, 96.8% in 1986, 95.8% in 1985 and 90.6% in 1984.[3,4,5,6,7,8,9,10,11]

Table 2-2 summarizes overall statistics by site. All sites collected an integrated sample from 6:00 a.m. to 9:00 a.m., local time. The overall average of the NMOC concentration is 0.404 ppmC.

In Table 2-2, the means presented are the arithmetic averages of the NMOC concentrations at each site. The numbers given for standard deviation, skewness, and kurtosis are the second, third, and fourth moments, respectively, about the arithmetic means. A skewness value greater than zero applies to distributions having a longer tail to the right. A distribution that is normally distributed would have a kurtosis of 3.0. A distribution more peaked (or pointed) than a normal distribution, having the same variance, would have a kurtosis greater than 3.0. All the kurtosis figures listed in this report are zero centered, which means that 3.0 has been subtracted from the fourth moment to give a reported kurtosis of 0.0 for a symmetrical distribution. The Shapiro-Wilk statistic (W) tests the normality of the data and ranges from zero to one. The closer the statistic is to one, the better the fit of the data to normality. Table 2-3 summarizes the 1993 NMOC data using the definitions that characterize a lognormal distribution overall and for each site. MU and SIGMA are the mean and standard deviation, respectively, of the logarithm of NMOC to the Napierian base e. The geometric mean is e raised to the power MU; the geometric standard deviation is e raised to the power SIGMA. The mode is the most frequently occurring NMOC value for a continuous probability distribution function.

Table 2-2

NMOC Overall Statistics, by Site

Site	Cases	Concentration, ppmC							
		Min	Max	Median	Mean	Std Dev	Skewness	Kurtosis	W[a]
LINY	80	0.060	0.996	0.225	0.283	0.180	1.942	4.280	0.806
NWNJ	82	0.090	1.446	0.368	0.402	0.199	1.953	8.138	0.887
P1PA	37	0.085	5.749	0.285	0.547	0.923	5.249	29.935	0.409
P2PA	41	0.059	4.076	0.259	0.445	0.649	4.685	25.408	0.486
PLNJ	73	0.069	1.754	0.368	0.442	0.301	1.556	3.949	0.884
OVERALL	313	0.059	5.749	0.298	0.404	0.445	7.644	80.607	0.511

[a]Shapiro-Wilk statistic to test normality of data.

Comparing W for a site in Tables 2-2 and 2-3 shows that the logarithmic transformation of the NMOC concentrations more nearly approximates the normal distribution. NMOC monitoring data can, therefore, be better characterized by a lognormal distribution than by a normal distribution, considering the findings of this and previous NMOC programs.[3,4,5,6,7,8,9,10,11]

Appendix C gives the daily NMOC concentration data listed chronologically for the entire sampling season. In addition, figures are given for each site for which NMOC concentrations in ppmC are plotted versus the 1993 Julian date when the sample was taken. Data tables for each site include the following:

- Calendar date sampled;

- Julian date samples;

- Sample ID number, assigned consecutively upon receipt of the sample;

- Sample canister number;

- Radian analytical measurement channel; and

- NMOC concentration in ppmC.

Appendix D lists invalidated or missing samples. Table D-1 lists these data chronologically for the sites participating in the NMOC program, while Table D-2 lists these data for the sites participating in the SNMOC program. For each sample, the tables list the site code, the date of the missing or invalid sample, a brief description of the possible cause of the invalid or missing sample, and the assigned cause for the failure.

Table 2-3

1993 LNMOC[a] Overall Statistics, by Site

Site	Concentration, ppmC						Concentration, ln(ppmC)		
	Cases	Min	Max	Median	Mean[b]	Mode	Mu[c]	Sigma[d]	W[e]
LINY	80	0.060	0.996	0.225	0.281	0.198	-1.42	0.552	0.971
NWNJ	82	0.090	1.446	0.368	0.404	0.253	-1.02	0.477	0.990
P1PA	37	0.085	5.749	0.285	0.483	0.085	-1.06	0.816	0.939
P2PA	41	0.059	4.076	0.259	0.406	0.188	-1.23	0.810	0.946
PLNJ	73	0.069	1.754	0.368	0.451	0.188	-1.04	0.698	0.976
OVERALL	313	0.059	5.749	0.298	0.390	0.188	-1.16	0.661	0.981

[a]LNMOC = ln(NMOC), when NMOC is in ppmC.
[b]Mean = exp (Mu + Sigma^2/2).
[c]Mu is the mean of ln(NMOC). e^{MU} is the geometric mean.
[d]Sigma is the standard deviation of ln(NMOC). e^{SIGMA} is called the geometric standard deviation.
[e]Shapiro-Wilk statistic to test normality of data.

3.0 NMOC TECHNICAL NOTES

This section summarizes descriptions of the installation and operation of the field sampling equipment, a summary of the analytical equipment and procedures for NMOC measurement, and a description of the canister cleanup equipment and procedures.

3.1 NMOC Field Sampling Equipment

Two types (A and B) of field sampling equipment were used to collect ambient air samples for NMOC measurement. In Type A, ambient air is drawn through a sintered stainless steel filter (2 micron) and critical orifice by a Metal Bellows® pump and delivered to a SUMMA® canister. In Type B, the ambient air is drawn through a sintered stainless steel filter and then through a fine adjust micrometering valve, a glass rotameter, a pump, and delivered to a SUMMA® canister. Components of both the samplers are made of stainless steel. Figures 3-1 and 3-2 are schematic diagrams of the NMOC sampling systems.

3.1.1 Installation

NMOC sampler installation configurations were site dependent. All field sites were installed by or under the direction of Radian personnel. Installation requirements included a temperature-controlled environment (70° to 86°F), close proximity to the atmosphere to be sampled, and noncontaminating sampler connections. Glass tubing or gas-chromatographic-grade stainless steel tubing and stainless steel fittings are the preferred materials of construction for all connections contacting the sample. Typical sampler installations involved three configurations, including slip stream connection off of a constant flow glass manifold, a slipstream connection (prior to the air monitoring station's NO_x analyzer) off of a stainless steel manifold with a bypass pump, and separate but collocated NMOC and NO_x sample inlet lines. For sites where the distance between the sample inlet and the stainless steel probe was greater than 8 feet, an auxiliary (by-pass) pump, as shown in Figures 3-1 and 3-2, was used. The auxiliary pump ensured
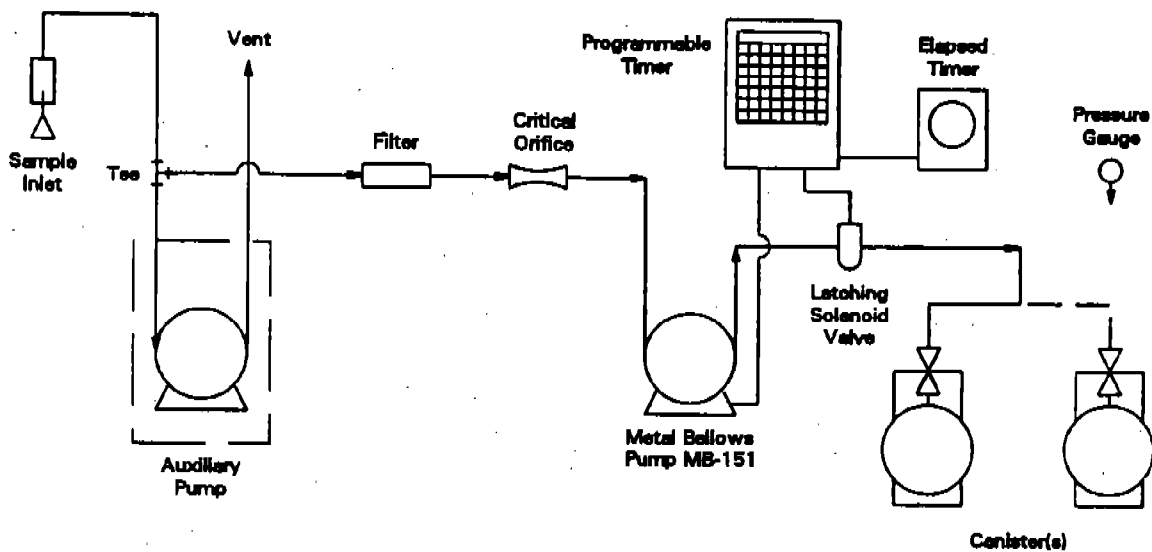
Figure 3-1. Style A Sampling System
for Collecting 3-hour Integrated Ambient Air Samples
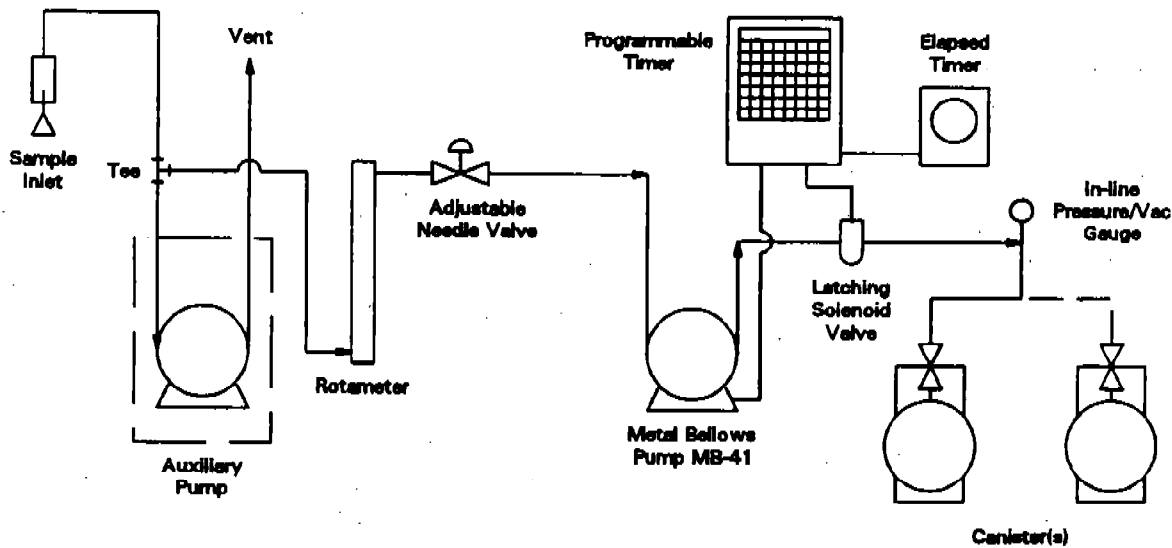
Figure 3-2. Style B Sampling System
for Collecting 3-hour Integrated Ambient Air Samples

that the air in the sample line was representative of the ambient air being sampled by pulling an excess of sample air in slipstream connection.

The critical orifice in the Style A sampler (Figure 3-1) was sized to maintain a constant collection flow rate that allowed a 6-L stainless steel canister to be taken from 0.5 mm mercury (Hg) vacuum (initial pressure) to about 15 psig (final pressure) in 3 hours. When duplicate samples were taken, the critical orifice used for single sample collection was replaced with an orifice sized to accommodate two 6-L canisters during the 3-hour sampling period.

For the Style B sampling system (Figure 3-2), the adjustable micro-metering valve was used to set a collection flow rate as indicated on the rotameter that allowed a 6-L stainless steel canister to be taken from the 0.5 mm Hg initial vacuum to about 15 psig in 3 hours. For duplicate samples, the indicated flow rate was doubled in order to accommodate two 6-L canisters during the sampling period. The rotameter settings for single and duplicate samples were determined in the lab using a bubble flow meter and were provided to the operators at installation.

3.1.2 Operation

Presampling - Style A System

The following instructions pertain to the sampling operation prior to collection of the field sample.

1. Verify timer program (see timer instructions). Set to MANUAL position to leak check sampling system. Once the system passes the leak check, turn timer to AUTO position.

2. With no canisters connected to the sampling system, turn the timer switch to the MANUAL position.

3.   Disconnect the sample inlet from the top of the orifice/filter assembly mounted on the pump inlet. Connect the rotameter to the top of the orifice/filter assembly. Tighten Swagelok® (1/4") fitting securely with a wrench. Do not over-tighten.

4.   Turn timer switch ON. Do not turn the power off and on rapidly. Wait 20 seconds between cycles to prevent premature timer/solenoid failure. The pump should run and the latching valve should open. Verify that the rotameter reading is approximately the same (±15%) as the reading obtained during installation as recommended on the orifice tag. If the rotameter reading is not correct, see the troubleshooting instructions.

5.   Allow the pump to run for at least 20 seconds, then press the timer OFF button.

6.   Connect a cleaned, evacuated canister to the sampling system. If duplicate samples are to be collected, remove the plug from the second port of the tee and connect a second canister to the sampling system. Remove the orifice assembly marked with an "S," denoting a single orifice. Install the orifice assembly marked with a "D," denoting a double orifice. Replace the filter holder on the "D" orifice. After obtaining scheduled duplicate samples, replace the plug and the "S" orifice assembly to return to single sample collection status.

7.   With the pump off, open completely the valve on the canister (or on one of the canisters if two are connected) and verify that no flow is registered on the rotameter. If any flow is detected by the rotameter, immediately close the canister valve and see the troubleshooting instructions.

8.   If no flow is observed, disconnect the rotameter and reconnect the inlet sample line to the filter assembly. If two canisters are connected, completely open the valve on the second canister.

9.   Reverify that the canister valve(s) is (are) completely open and the timer is properly set for sampling from 6 a.m. to 9 a.m. the next weekday. Set timer to AUTO mode.

10. Reset the elapsed time counter.

Presampling - Style B System

The following instructions pertain to the sampling operation prior to collection of the field sample.

1. Verify timer program (see timer instructions). Set to MANUAL position to leak check sampling system. Once the system passes the leak check, turn timer to AUTO position.

2. With no canisters connected to the sampling system, turn the timer switch to the MANUAL position.

3. Turn timer switch ON. Do not turn the power off and on rapidly. Wait 20 seconds between cycles to prevent premature timer/ solenoid failure. The pump should run and the latching valve should open (audible click with 2 to 5 seconds delay). Verify that the rotameter reading is approximately the same (±15%) as the reading obtained during installation as recommended in the installation instructions. If the duplicate samples are to be collected set the rotameter to the duplicate flow rate. If the rotameter reading is not correct see the troubleshooting instructions.

5. Allow the pump to run for at least 20 seconds, then press the timer OFF button.

6. Connect a cleaned, evacuated canister to the sampling system. If duplicate samples are to be collected, remove the plug from the second port of the tee and connect a second canister to the sampling system.

7. With the pump off, open completely the valve on the canister (or on one of the canisters if two are connected) and verify that a 29" vacuum exists. Close the can and observe the vacuum gauge. If the vacuum begins to drop see the troubleshooting instructions, a leak probably exists.

8. If two canisters are connected, completely open the valve on the second canister.

9. Reverify that the canister valve(s) is (are) completely open and the timer is properly set for sampling from 6 a.m. to 9 a.m. the next weekday. Set timer to AUTO mode.

10. Reset the elapsed time counter.

Postsampling

The following instructions outline the NMOC postsampling operation procedures in the field.

1. Close the canister valve(s) firmly.

2. Record the pressure reading(s) on the data sheet(s). Disconnect the canister(s). If the pressure reading is not at least 11 psig, see the troubleshooting instructions.

3. Fill in the required information on the NMOC sampling field data form. PLEASE PRESS HARD AND WRITE WITH A BALLPOINT PEN; YOU ARE MAKING THREE COPIES. (see Figure 3-3).

4. Verify elapsed time counter reading equals 3 hours.

5. Verify that the timer shows the correct time setting. If not, note that fact on the sample form along with any information pertaining to the possible cause. Reset the timer to the correct time, if necessary.

6. Verify that the canister valves are closed firmly. Do not over-tighten them. Put the protective cap(s) on the valve(s) and prepare the canister(s) for shipment to the Radian, RTP laboratory.

3.1.3 Troubleshooting Instructions

A list of troubleshooting instructions was given to each field site during site installation and operator training. Typical problems encountered with the field sampling apparatus included: loose fittings, misprogrammed timer, or clogged orifices. To minimize downtime, field site operators were encouraged to relay sampling problems to the Radian laboratory daily by telephone. Most sampling problems were addressed promptly through these telephone discussions.

3.1.4 Sampler Performance for 1993

The NMOC sampler was modified in 1989 to improve performance. This modification involved replacing the mechanical timer previously used with an electronic version. The electronic timer improved sample integration. An elapsed time meter was added to the sampler to verify sample collection duration. This system was used as the

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NMOC SAMPLING FIELD DATA FORM

Site Code : _____ AIRS #:__ __ - __ __ __ __ · __ __ __ __ __

Site Location : City: _____ State: _____

Sample Collection Date : _____ Sampling Period : _____

Operator : _____ Elapsed Time : _____

Final Canister Pressure (psig) : _____

Sample Canister Number : _____ . Side : _____

Sample Duplicate for this Date : Yes☐   No☐

If yes, Duplicate Canister Number : _____

NOx Analyzer Operating? Yes☐ No☐

If yes, Average Reading (ppmv as NOx) : _____

Average Wind Speed : _____ Average Wind Direction : _____

Rotameter Indicated Flow Rate : _____ Orifice Number : _____

Average Barometric Pressure (mm Hg or inches Hg) : _____

Ambient Temperature (°F) : _____ Relative Humidity : _____

THC Model (if available) : _____ Average THC : _____

Sky/Weather Conditions : _____

Site Conditions/Remarks : _____

_____

Canister Number : _____

Initial Canister Vacuum : _____

Received By : _____

Date : _____

Sample Validity : _____

If Invalid, Reason : _____

0781189R

Figure 3-3. NMOC Sampling Field Data Form

3-7

Style A sampler during the 1993 program. The NMOC sampling system was also modified for the 1992 season. The Style B system eliminated the use of orifices and instead used an adjustable micro-metering valve and in-line rotameter.

In addition to the modifications, all samplers and canisters were subjected to a preseason QC check to ensure field performance. All orifices provided with each Style A sampling system were checked against the removable rotameter and referenced to a primary standard (bubble flowmeter). For the Style B sampler, the in-line rotameters were also calibrated against a primary standard (bubble flowmeter). Prior to field installation, each sampler was operated in the laboratory to establish an expected final sample pressure range. For the Style A samplers, two single orifices and one double orifice were tested for each sampler kit.

Due to the preseason checks and modifications, the NMOC sampler performance was improved for the 1993 sampling season. Invalid samples were primarily due to operator error and equipment malfunctions. Completeness can be improved at all sites through greater attention to sampling procedure, and by ensuring that trained site personnel are available. A further improvement in completeness may be possible as site operators gain familiarity with the electronic timer. Revised sampler operating instructions will focus additional attention on timer programming and operation, and will include a daily checklist to eliminate common operator errors.

A total of 63 invalid/missing samples were recorded in the 1993 NMOC monitoring program (this included 18 samples for NMOC and 45 samples for SNMOC). Appendix D lists the invalid/missing samples in chronological order, along with the reason for invalidation. Avoidable operator error accounts for 29% and equipment problems account for 46% of the invalidated samples. Twenty-four percent were missed sample collections for unknown reasons. The remaining 1% reflects missed sample collections due to site inaccessibility.

3.1.5 Field Documentation

The field sample collection information was documented by the site operator on pre-printed multiple part forms. Figure 3-3 is an example NMOC sampling field data form. Each canister sent to the field was accompanied by this form. A copy of the field data form was retained by the site operator for the site notebook. Figure 3-4 is an example of the invalid sample form. This form was completed by the site operator to document the reasons for a missed sample or an invalid field sample collection.

3.2 NMOC Analysis

The NMOC analysis equipment and the analysis procedure are described in detail in Appendix B. A brief description of the equipment and operating procedure used in this study follows.

3.2.1 Instrumentation

Two gas chromatographs were used by Radian. Each was a dual-channel Hewlett-Packard Model 5880 (HP-5880) using flame ionization detection (FID). NMOC instrument Channels A and B refer to the two FIDs on one HP-5880 unit, and Channels C and D refer to the two FIDs on the other HP-5880 unit. These chromatographs were configured for PDFID analysis, consistent with the reference system (EPA-QAD instrument), described in Appendix B.

3.2.2 Hewlett-Packard, Model 5880, Gas Chromatograph Operating Conditions

The sample trap consisted of 30 cm of 1/8-inch outside diameter (o.d.) stainless steel tubing, packed with 60/80 mesh glass beads.

Three support gases were used for PDFID analysis: helium, hydrogen, and hydrocarbon-free air.

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V-

NMOC INVALID SAMPLE FORM

Site Code : _____ AIRS #:__ __ - __ __ __ __ - __ __ __ __

City : _____ State : _____

Sample Collection Date : _____ Operator : _____

Sample Canister Number : _____

Sample Duplicate for this Date : Yes ☐ No ☐

If Yes, Duplicate Canister Number : _____

Reason for Invalid or Missed Sample : _____

_____

_____

Average NOx Analyzer Reading for this Collection Date : _____

Wind Speed : _____ Wind Direction : _____

Rotameter Indicated Flow Rate : _____ Orifice Number : _____

Average Barometric Pressure (mm Hg or inches Hg) : _____

Ambient Temperature (˚F) : _____ Relative Humidity : _____

Sky/Weather Conditions : _____

_____

_____

Received By : _____
Date : _____
Action Taken : _____

_____

Resolution : _____

_____

Field Invalid or In-house Invalid

078118BR

Figure 3-4. NMOC Invalid Sample Form

The operating temperatures of the HP-5880 were controlled for the PDFID analysis. The FID and auxiliary zone were controlled at 250°C and 90°C, respectively. The oven temperature was programmed from 30°C to 90°C at a rate of 30°C per minute for 4 minutes, holding at 90°C for the fourth minute. Oven and integration parameters were controlled by Hewlett-Packard HP Level 4 programmable integrators. A complete listing of the integrator programming sequence for NMOC measurement by the PDFID method is given in Appendix E.

3.2.3 NMOC Analytical Technique

The modified HP-5880, dual-FID chromatographs were operated during the 1993 study according to a project specific Standard Operating Procedure (SOP). Further description is given below to help explain the analytical apparatus and procedure.

The six-port valve shown in Figure 3-5 was installed in the auxiliary heated zone of the HP-5880 and was pneumatically actuated using chromatographic valve control signals to apply either compressed air or vacuum to the valve. The sample trap itself was located inside the chromatograph's column oven. A section of 1/8-inch o.d. stainless steel tubing was sized to a length that prevented pressure surges from extinguishing the FID flame. This length was determined experimentally and differs for each chromatograph and for each channel within chromatographs. Although the length of tubing effectively substitutes for the pressure restriction provided by a column, it does not perform the separation function of a column.

During sample trapping, an excess of sample gas flow from the canister was maintained to ensure back diffusion of room air into the trap did not occur. A pressure change of 80 mm Hg in a 1.7-L vacuum reservoir was used to gauge and control the volume of sample gas cryogenically trapped. After the trapping cycle was complete, the HP-5880 program shown in Appendix E was initiated. When the program triggered a horn emitting an audible beep, the cryogen was removed from the trap and the oven

Figure 3-5. NMOC Analytical Equipment

6870355F
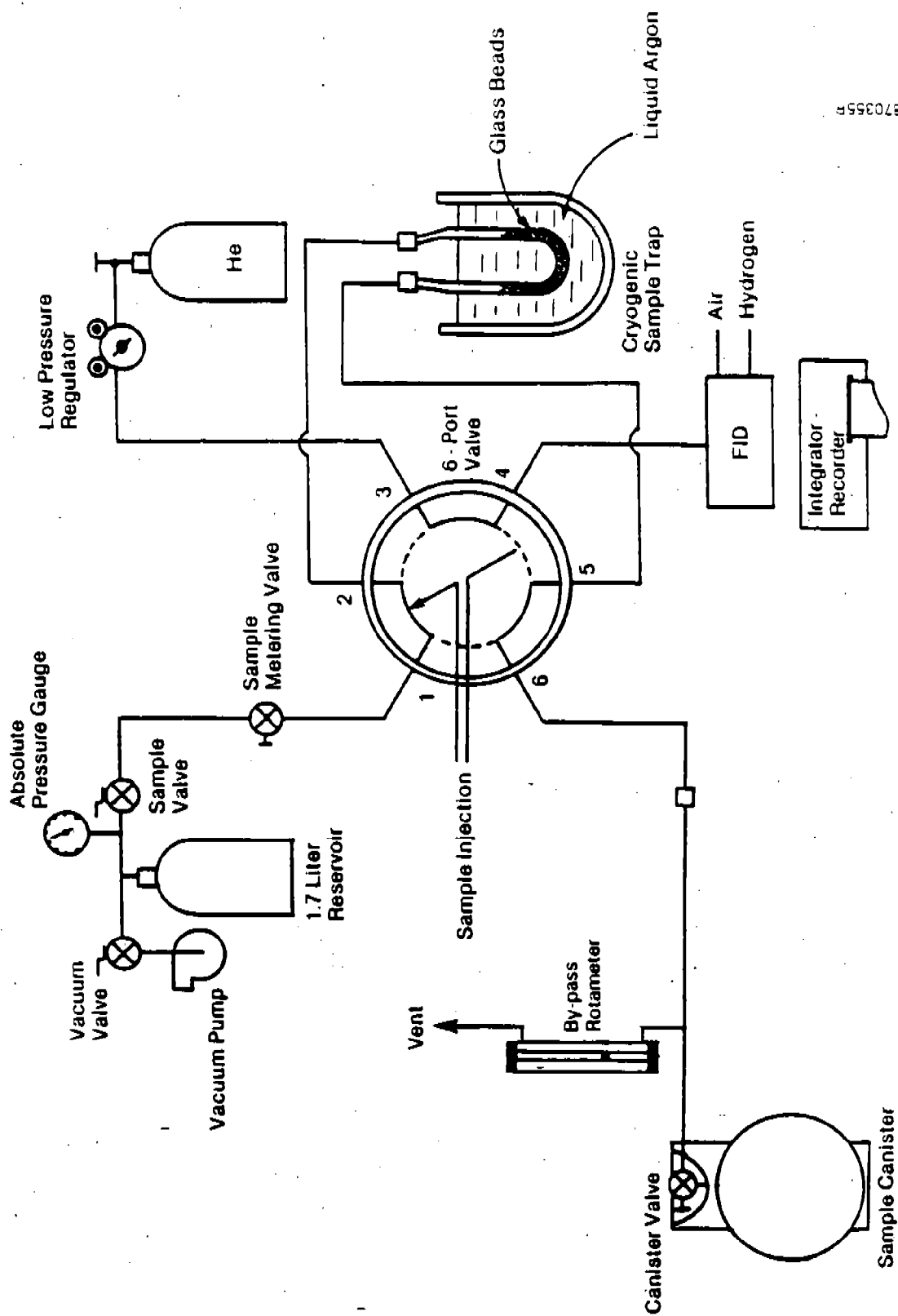
door was closed. The chromatographic program then assumed control of raising the oven temperature, at the preset rate, to release the trapped sample to the FID, and set up the integration parameters.

3.3   Canister Cleanup System

A canister cleanup system was developed and used to prepare sample canisters for reuse after analysis. A cleanup cycle consisted of first pulling a vacuum of 0.5 mm Hg absolute pressure in the canister, followed by pressurizing the canister to 20 psig with cleaned, dried air that had been humidified. This cycle was repeated two more times during the canister cleanup procedure. The cleanness of the canister was qualified by PDFID analysis. Upon meeting the cleanness criterion of 20 ppbC, the canister was evacuated to 0.5 mm Hg absolute pressure a fourth time, in preparation for shipment to the site.

3.3.1   Canister Cleanup Equipment

A diagram of the canister cleanup system is shown in Figure 3-6. An oil-free compressor with a 12-gallon reservoir provided source air for the system. The oil-free compressor was chosen to minimize hydrocarbon contamination. A coalescing filter provided water mist and particulate matter removal down to a particle size of one micron. Permeation dryers removed water vapor from the compressor source air. These permeation dryers were followed by moisture indicators to show detectable moisture in the air leaving the dryer. The moisture indicators never showed any water, indicating that the permeation dryers effectively removed all water vapor.

Air was then passed through catalytic oxidizers to destroy residual hydrocarbons. The oxidizers were followed by in-line filters for secondary particulate matter removal and by a cryogenic trap to condense any water formed in the catalytic oxidizers and any organic compound not destroyed by the catalytic oxidizer. A single-stage regulator controlled the final air pressure in the canisters and a metering valve was used to control
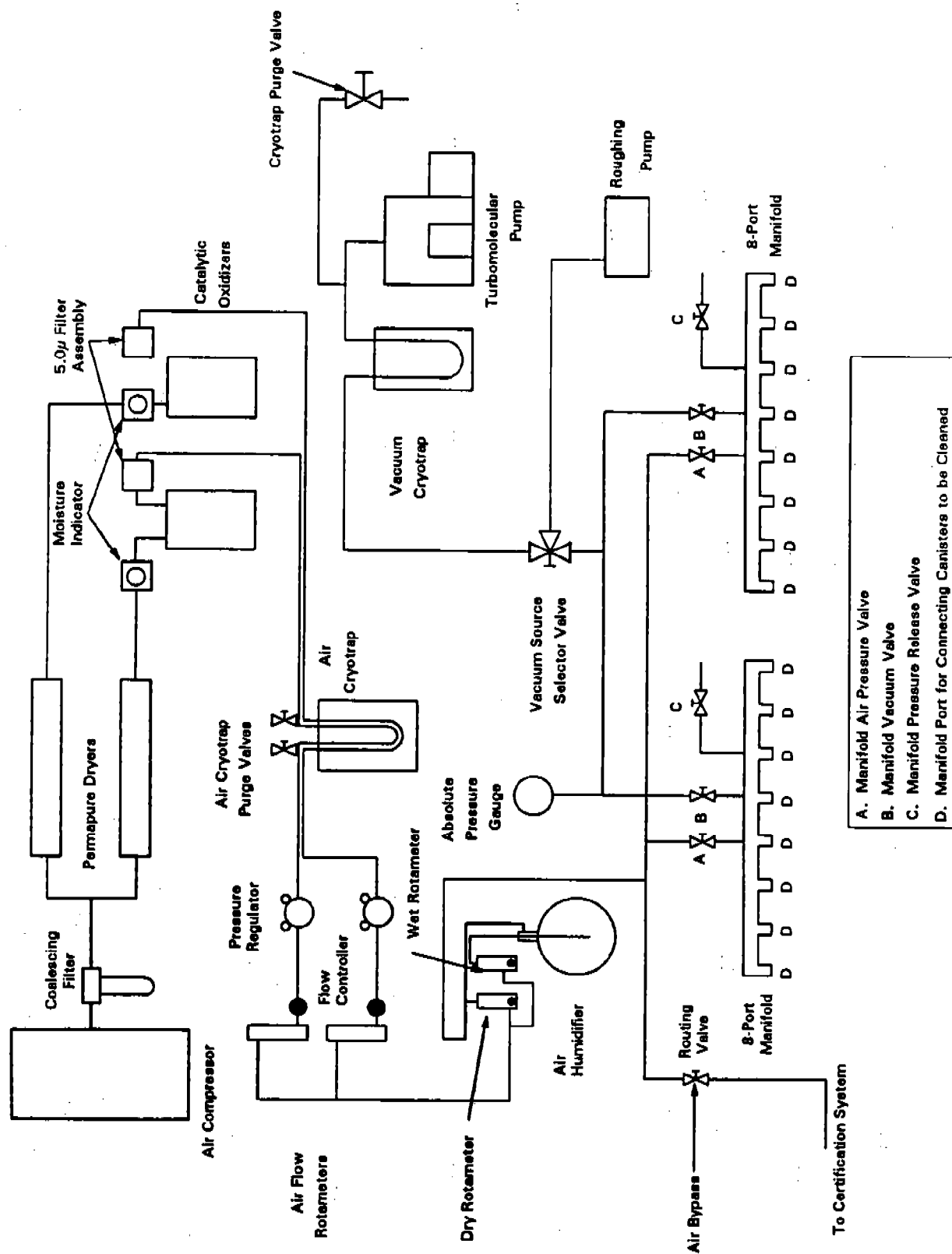
Figure 3-6. Canister Cleanup Apparatus

A. Manifold Air Pressure Valve
B. Manifold Vacuum Valve
C. Manifold Pressure Release Valve
D. Manifold Port for Connecting Canisters to be Cleaned

the flow rate at which the canisters were filled during each cleanup cycle. The air flow was indicated by a rotameter installed in the clean, dried air line. There was a shutoff valve between the rotameters and the humidifier system. The humidifier system consisted of a SUMMA® treated 6-L canister partially filled with high performance liquid chromatographic-grade (HPLC-grade) water. One flowmeter and flow-control valve routed the cleaned, dried air into the 6-L canister where it was bubbled through the HPLC-grade water. A second flow-control valve and flowmeter allowed air to bypass the canister/bubbler. By setting the flow-control valves separately, the downstream relative humidity was regulated. Since the 1990 study, 80% relative humidity has been used for canister cleaning. There was another shutoff valve between the humidifier and the 8-port manifold where the canisters were connected for cleanup.

The vacuum system consisted of a Precision Model DD-310 turbomolecular vacuum pump, a cryogenic trap, an absolute pressure gauge, and a bellows valve connected as shown in Figure 3-6. The cryogenic trap prevented the sample canisters from being contaminated by back diffusion of hydrocarbons from the vacuum pump into the cleanup system. The bellows valves enabled isolation of the vacuum pump from the system without shutting off the vacuum pump.

3.3.2 Canister Cleanup Procedures

After all analyses were completed, a bank of eight canisters was connected to each manifold shown in Figure 3-6. The valve on each canister was opened, with the shutoff valves and the bellows valves closed. The vacuum pump was started and one of the bellows valves was opened, drawing a vacuum on the canisters connected to the corresponding manifold. After reaching 0.5 mm Hg absolute pressure as indicated by the absolute pressure gauge, the vacuum was maintained for 30 minutes on the eight canisters connected to the manifold. The bellows valve was then closed and the cleaned, dried air that had been humidified was introduced into the evacuated canisters until the pressure reached 20 psig. The canisters were filled from the clean air system at the rate of 7.0 L/min. This flow rate was recommended by the manufacturer as the highest flow

rate at which the catalytic oxidizers could handle elimination of hydrocarbons with a minimum of 99.7% efficiency.

When the first manifold had completed the evacuation phase and was being pressurized, the second manifold was then subjected to vacuum by opening its bellows valve. After 30 minutes, the second manifold was isolated from the vacuum and connected to the clean, dried air that had been humidified. The first manifold of canisters was then taken through a second cycle of evacuation and pressurization. Each manifold bank of eight canisters was subjected to three cleanup cycles.

During the third cleanup cycle, the canisters were pressurized to 20 psig with clean, dried air that had been humidified. For each bank of eight canisters, the canister having the highest pre-cleanup NMOC concentration was selected for NMOC analysis to determine potential hydrocarbon residues. If the analysis measured less than 0.020 ppmC, then the eight canisters on the manifold were considered to be clean. Finally, the canisters were again evacuated to 0.5 mm Hg pressure absolute, capped under vacuum, and then packed in the containers used for shipping to the field sites.

4.0 NMOC QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

This section details the steps taken in the 1993 NMOC monitoring program to ensure that the data collected were of known quality and were well documented. Analysis results are given in terms of precision, completeness, and accuracy. Repeated analyses provided analytical precision. Duplicate samples provided sampling and analysis precision. Completeness was measured in terms of percent of scheduled samples that resulted in valid samples, beginning with the first valid site-specific sample collected and ending with the last scheduled site-specific sample. Accuracy of NMOC concentrations was reported as percent bias of audit samples of or referenced to a propane NIST standard reference mateiral (SRM) by a U.S. EPA contractor.

4.1 Introduction and Conclusions

Completeness for the 1993 NMOC study was 94.5% indicating that good communication and planning were maintained between the site personnel and the laboratory personnel. Precision for the 1993 NMOC study averaged 22.54% absolute percent difference of repeated analysis and compared to 21.61% for 1992, 14.2% for 1991, 7.6% for 1990, 14.2% for 1989, 10.1% for 1988, 9.61% for 1987, 9.01% for 1986, and 10% for 1985. These are excellent results based on the low concentrations measured during the program.

Bias of the Radian channels for the 1993 audit results ranged from +1.8% to +8.5 percent. In 1992, the accuracy determined from the external audit samples ranged from -3.4% to +24.0%, from +1.9% to +8.9% in 1991, from -3.2% to +6.2% in 1990, from +1.3% to +4.5% in 1989, from 1.3% to 4.5% in 1988, and from -2.9% to -0.06% in 1987. In 1986 bias ranged from -0.52% to -3.3% and in 1985 bias ranged from -2.3% to +5.2 percent.

An initial multipoint performance evaluation was conducted using the propane responses for each of the four analytical measurement channels. Daily calibration checks and in-house propane QC samples monitored instrument and operator performance. Duplicate site samples demonstrated good overall sampling and analysis precision.

Data validation was performed on 10% of the 1993 NMOC data base, as described later in this section.

Calibration and drift determinations showed that the instrumentation was stable and the calibration procedures were consistent. Canister cleanup results showed there was negligible carryover from one sample to the next. In-house QC samples of propane demonstrated that the analytical systems were in control.

Precision, accuracy, and completeness results for 1993 are comparable to results from previous years and indicate that the data is of good quality and meet the data quality objectives specified in the QAPP[2].

4.2 Calibration and Instrument Performance

Initial performance assessments for NMOC were conducted with propane. Daily calibrations were checked with approximately 3.0 ppmC propane for the NMOC measurements.

4.2.1 Performance Assessment

An initial multipoint performance evaluation was conducted on each analytical measurement channel, using propane referenced to a propane NIST CRM No. 1666B. The concentration of the propane used in the performance assessment ranged from 2.971 to 19.073 ppmC. The "zero" value was determined using cleaned, dried air from the canister cleanup system described previously in Section 3. Table 4-1 summarizes the performance assessments. The FID responses for multiple concentration propane

Table 4-1

1993 Performance Assessment Summary, Radian Channels

Radian Channel	Cases	Linear Regression Results[a]		
		Intercept	Slope	Coefficient of Correlation
A	20	248.774	3181.774	0.999772
B	20	265.721	3231.343	0.999815
C	20	435.067	3082.526	0.999649
D	20	778.488	2907.654	0.999178

[a]Figures 4-1 through 4-4 plot propane area counts vs. concentration in ppmC.

standards were linear, having coefficients of correlation from 0.999178 to 0.999815. Figures 4-1 through 4-4 show plots of the NMOC performance results for Radian Channels A, B, C, and D, respectively. The plots show the regression line.

4.2.2 Calibration Zero, Span, and Drift

Radian PDFID channels were tested daily for zero and span. Zero readings were measured using cleaned, dried air. The zero air was supplied by the same system that cleans air for the canister cleanup system. Span readings used a mixture of about 3.0 ppmC propane in dry air. Calibration factors were calculated from the span and zero readings for each measurement channel. Initial calibration factors were determined in the morning before any site samples were analyzed and final calibration factors were determined in the afternoon on randomly selected days after all the ambient air samples had been analyzed. Percent calibration factor drifts were determined based on the initial calibration factor. The data for zeros, calibration factors, and calibration factor drifts are given in Appendix F for each Radian channel and each calendar day of the analysis season. Figures 4-5 through 4-8 show plots for daily calibration zeros for Radian Channels A, B, C, and D. Figures 4-9 through 4-12 show the daily calibration span data as a function of the 1993 Julian date. Figures 4-13 through 4-16 show the daily percent drift data for Radian Channels A, B, C, and D indicating the maximum percent drift was 3.32. The average absolute percent drift ranged from 0.023% for Channel B to 0.549% for Channel C.

4.2.3 Calibration Drift

Summary calibration factor drift data are given in Table 4-2. The table presents calibration factor drift, percent calibration factor drift, and absolute percent calibration factor drift. Calibration factors were calculated from an analysis of a propane-air

Four-Point Calibration – 1993
Channel A
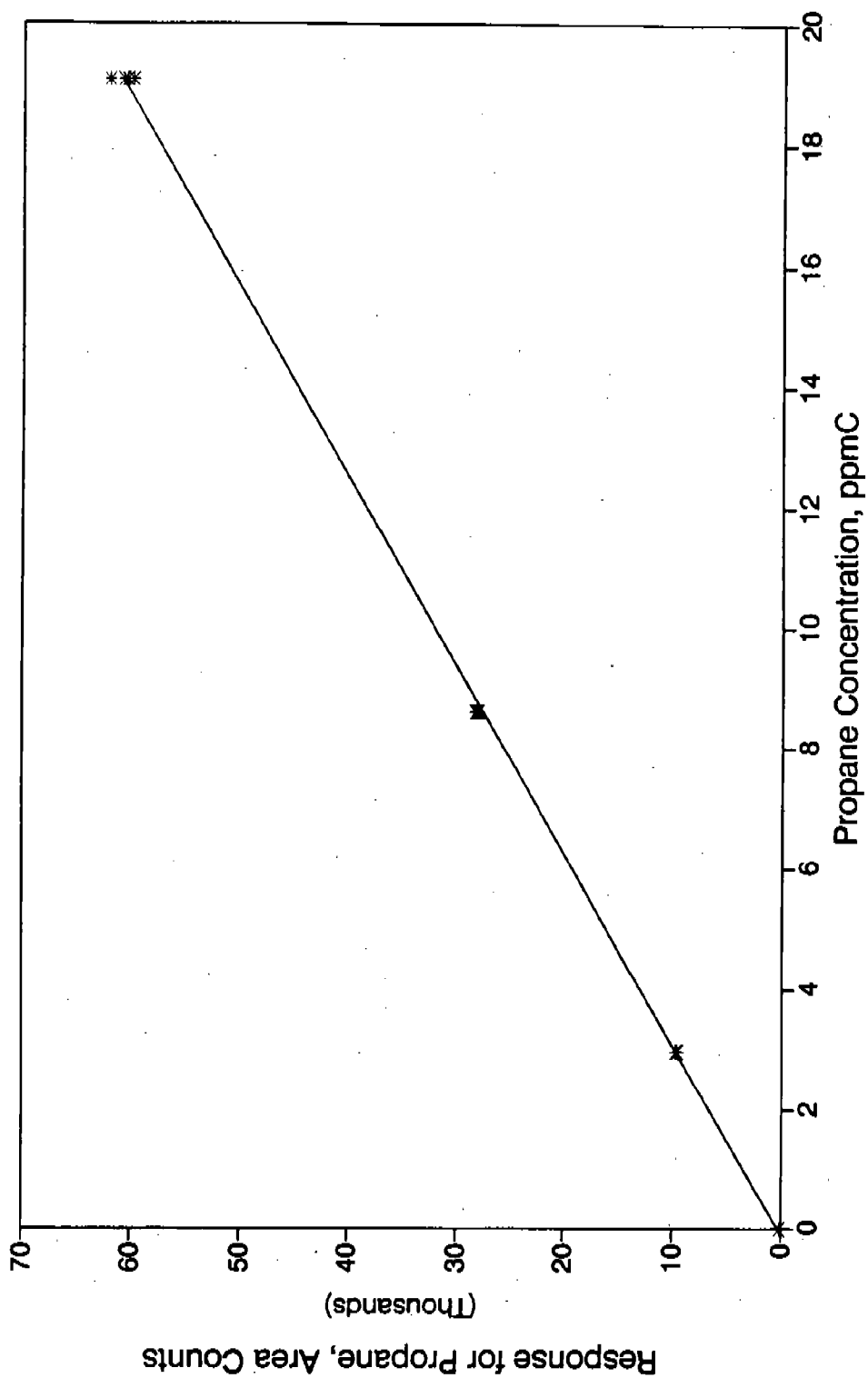
Figure 4-1. NMOC performance results, Channel A.

Four-Point Calibration - 1993
Channel B
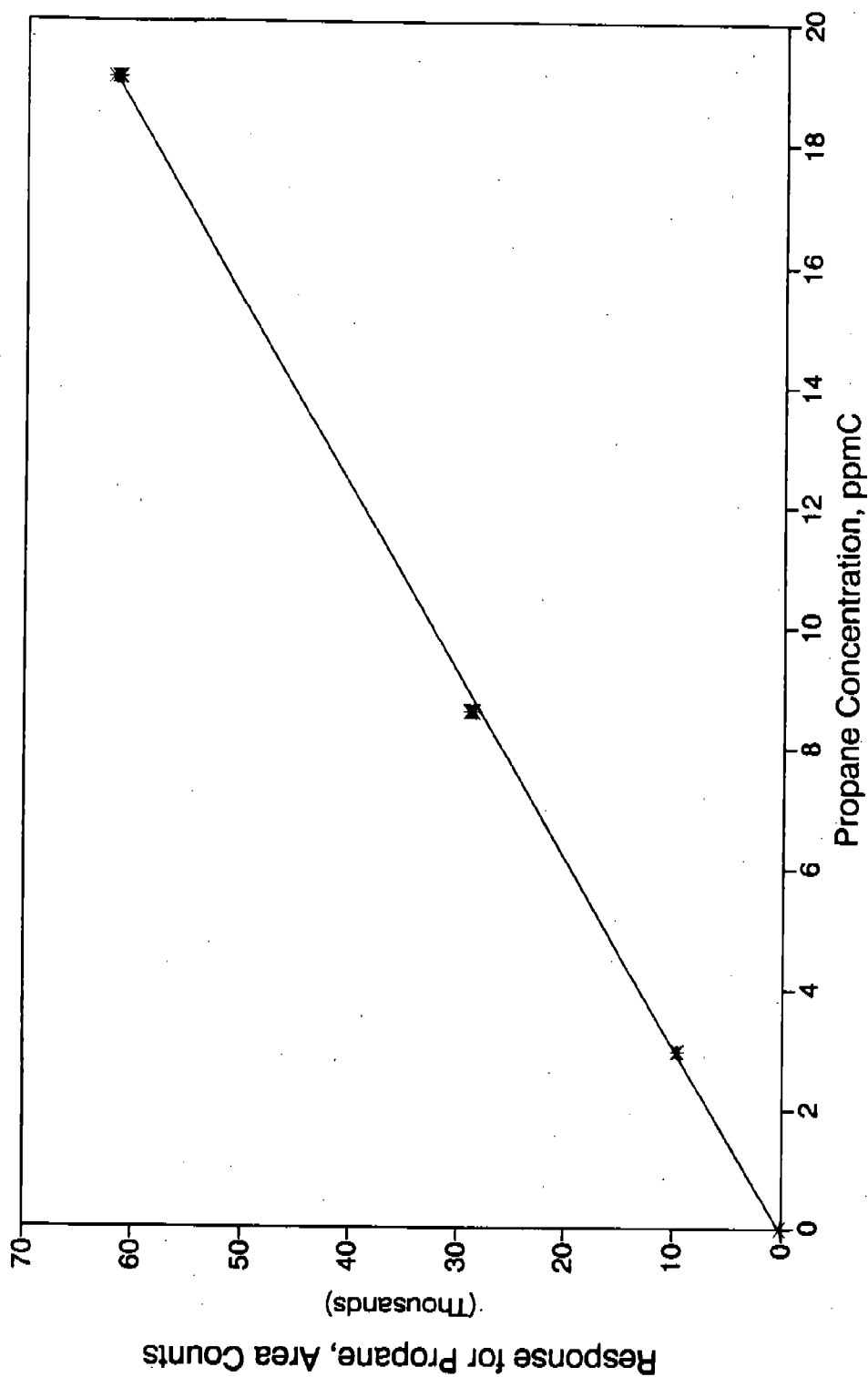
Figure 4-2. NMOC performance results, Channel B.

Four-Point Calibration - 1993
Channel C
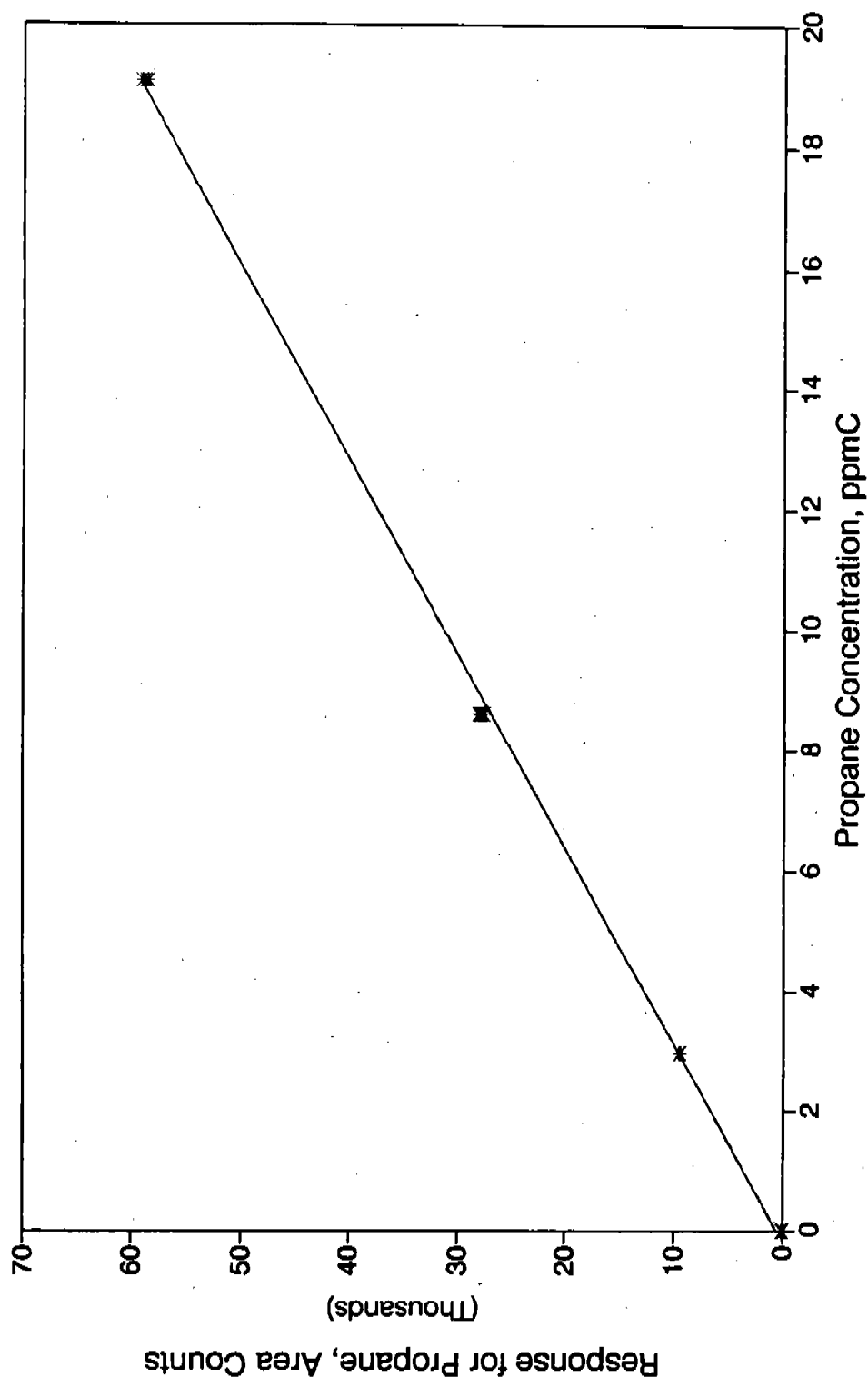
Figure 4-3. NMOC performance results, Channel C.

Four-Point Calibration – 1993
Channel D
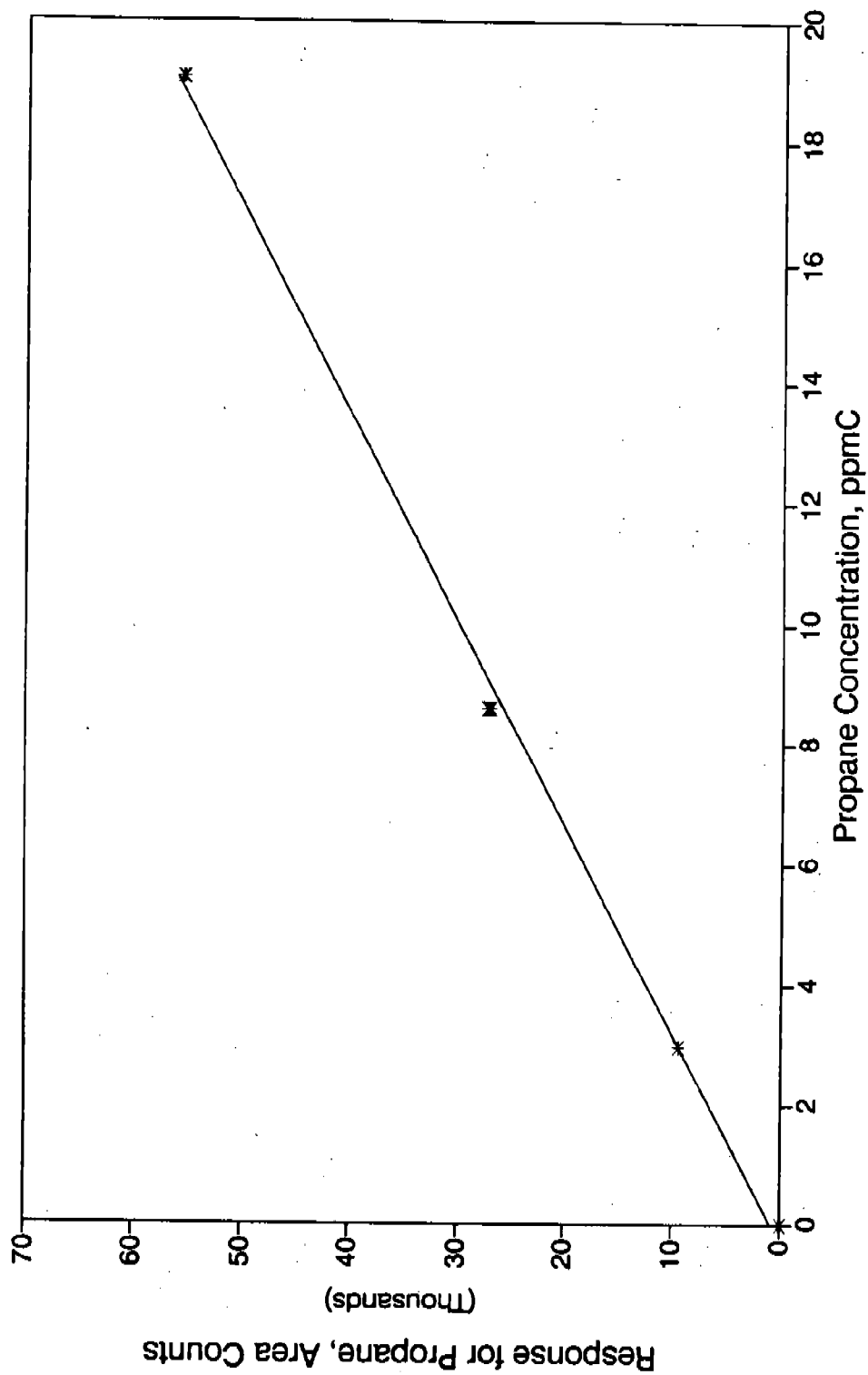
Figure 4-4. NMOC performance results, Channel D.

DAILY CALIBRATION - ZERO
Radian Channel A
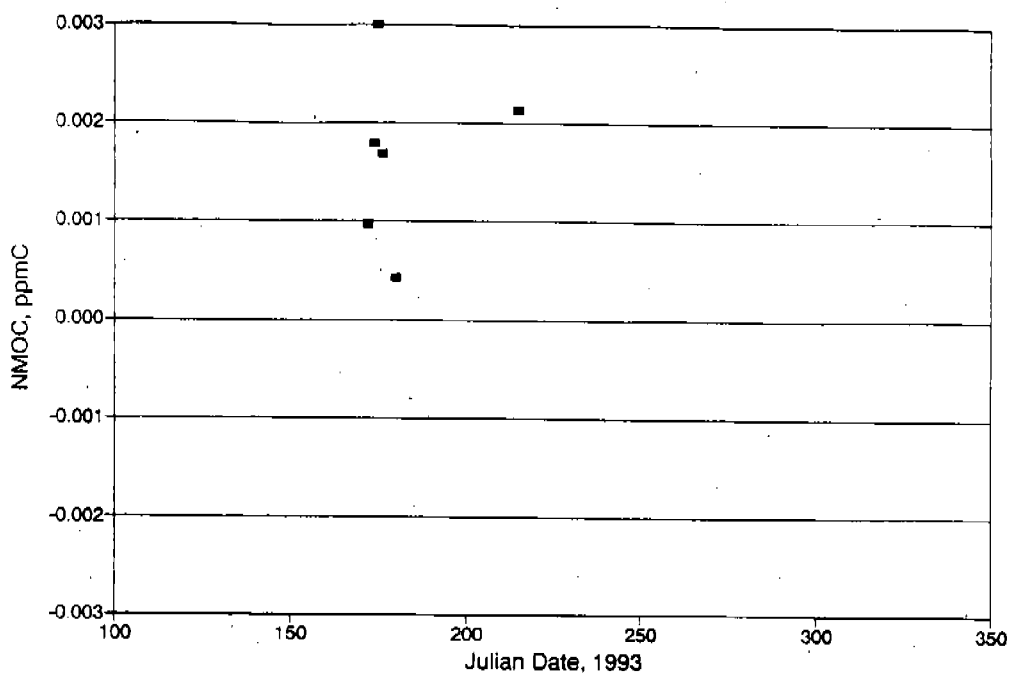
Figure 4-5. Daily Calibration Zero, Channel A

DAILY CALIBRATION - ZERO
Radian Channel B
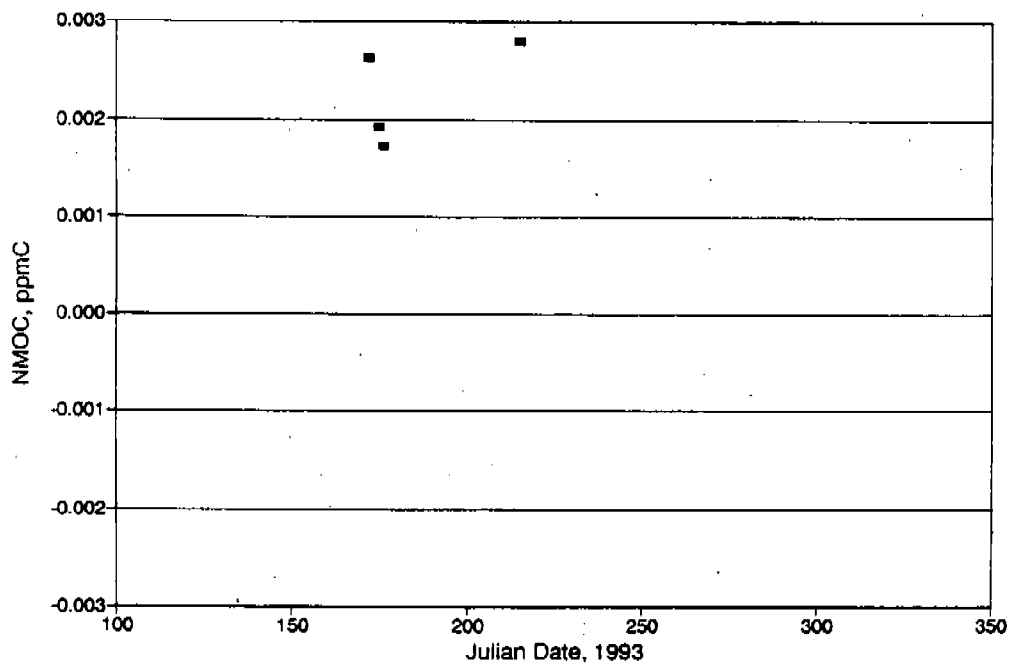
Figure 4-6. Daily Calibration Zero, Channel B

DAILY CALIBRATION - ZERO
Radian Channel C
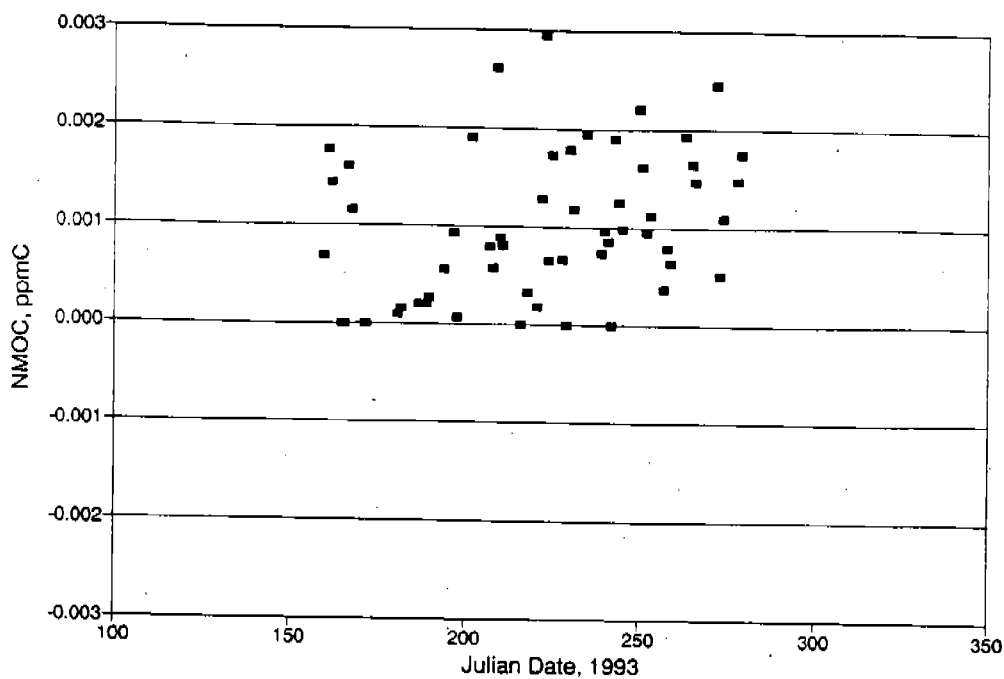
Figure 4-7. Daily Calibration Zero, Channel C

DAILY CALIBRATION - ZERO
Radian Channel D
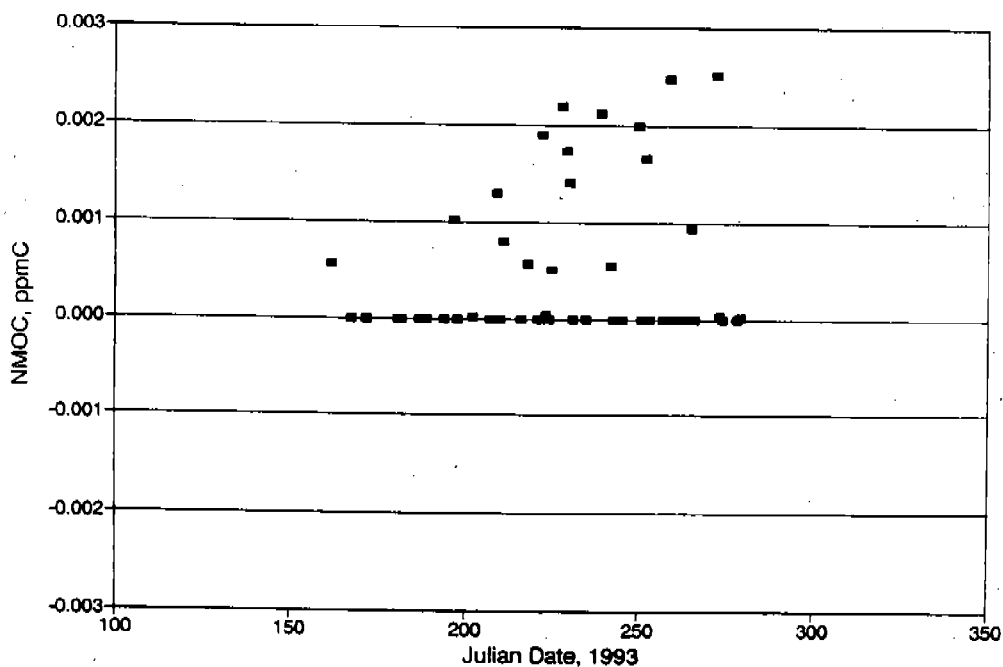
Figure 4-8. Daily Calibration Zero, Channel D

DAILY CALIBRATION - SPAN
Radian Channel A
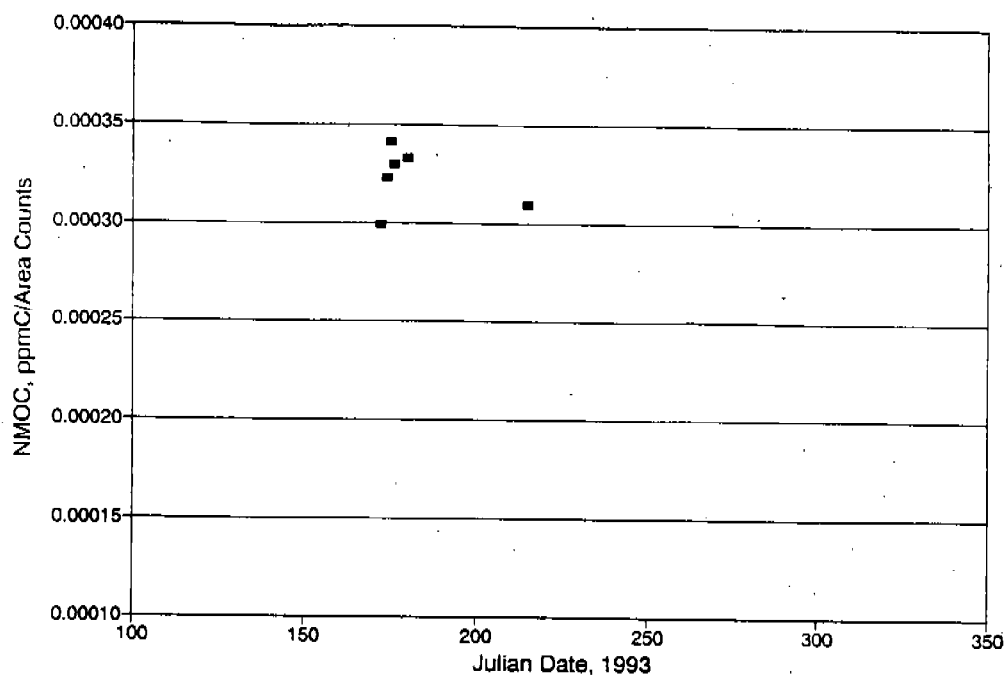
Figure 4-9. Daily Calibration Span, Channel A

DAILY CALIBRATION - SPAN
Radian Channel B
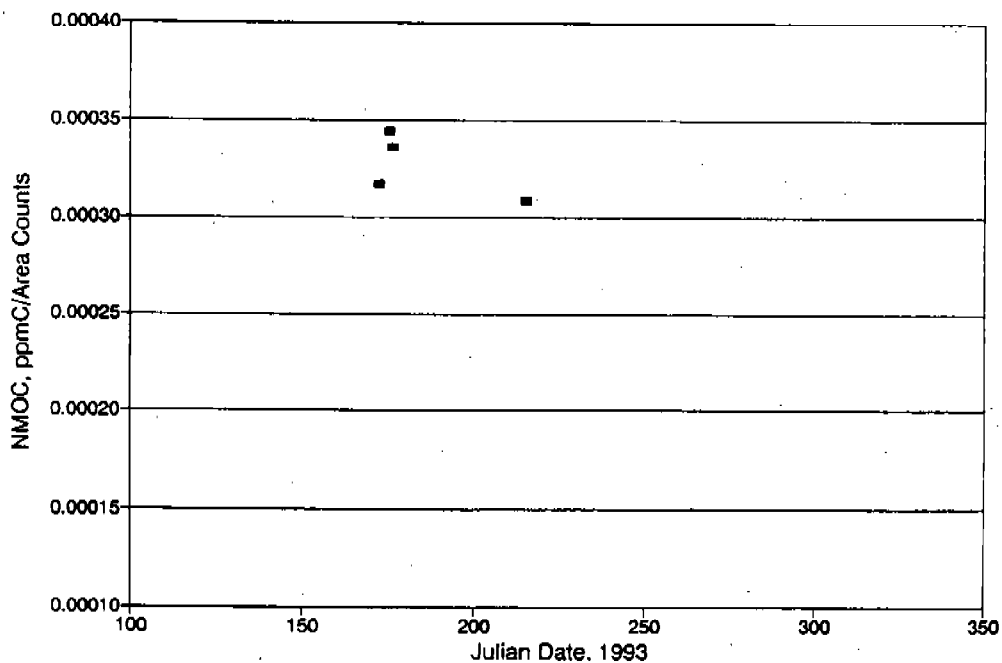
Figure 4-10. Daily Calibration Span, Channel B

DAILY CALIBRATION - SPAN
Radian Channel C
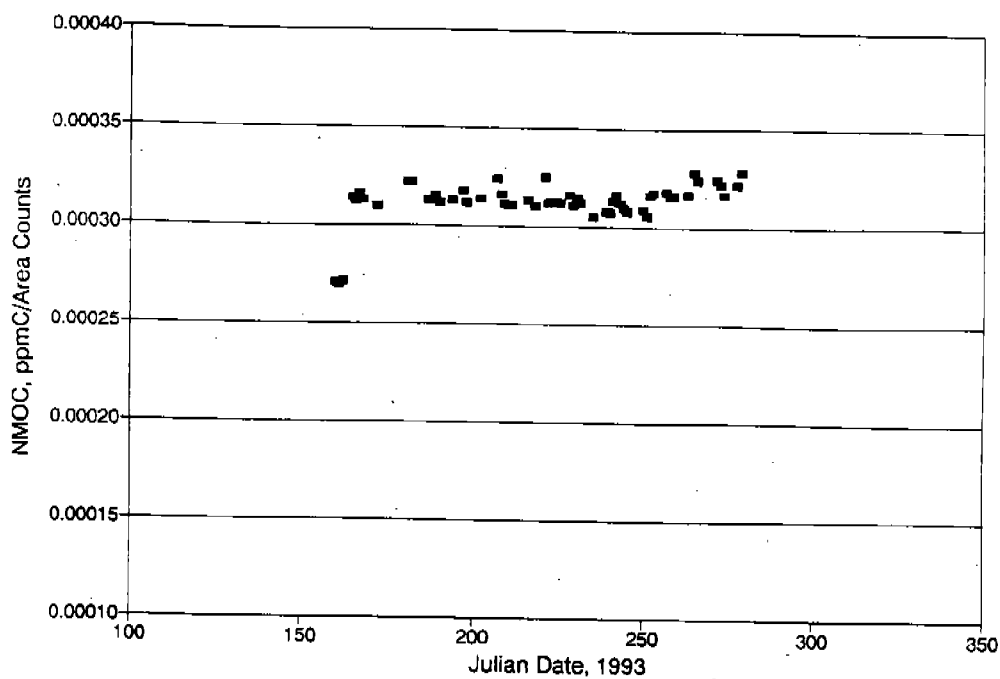
Figure 4-11. Daily Calibration Span, Channel C

DAILY CALIBRATION - SPAN
Radian Channel D
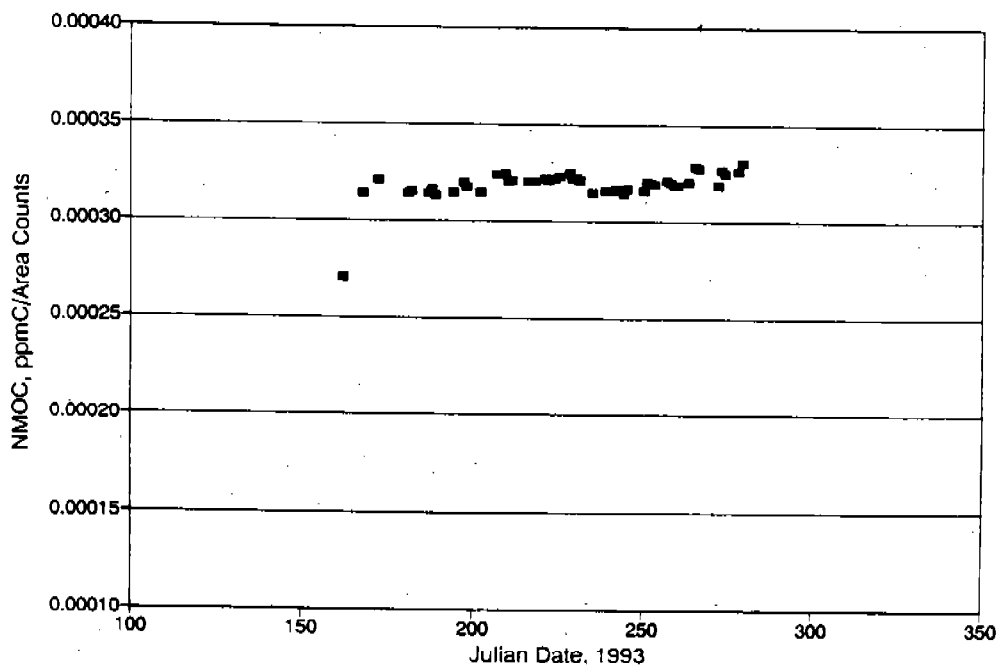
Figure 4-12. Daily Calibration Span, Channel D

4-12

DAILY CALIBRATION - PERCENT DRIFT
Radian Channel A
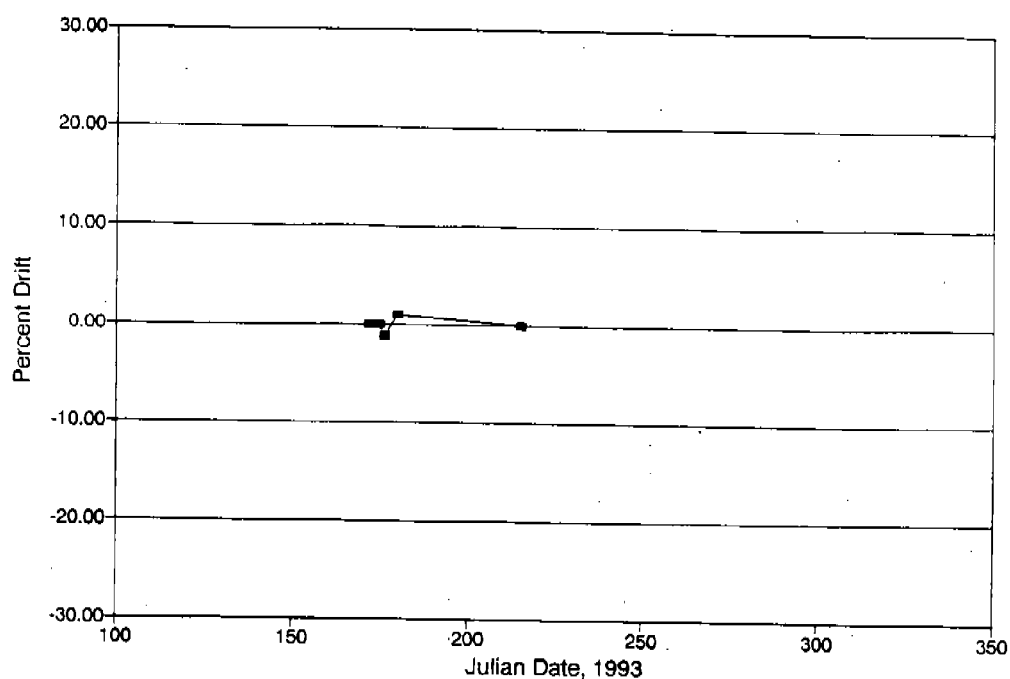
Figure 4-13. Daily Calibration Percent Drift, Channel A

DAILY CALIBRATION - PERCENT DRIFT
Radian Channel B
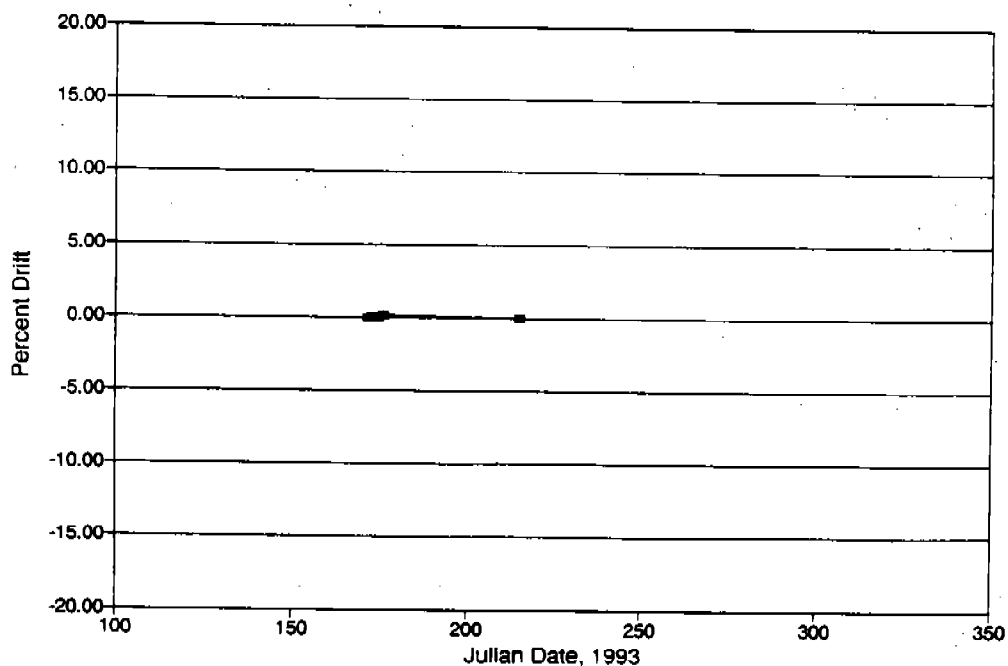
Figure 4-14. Daily Calibration Percent Drift, Channel B

DAILY CALIBRATION - PERCENT DRIFT
Radian Channel C
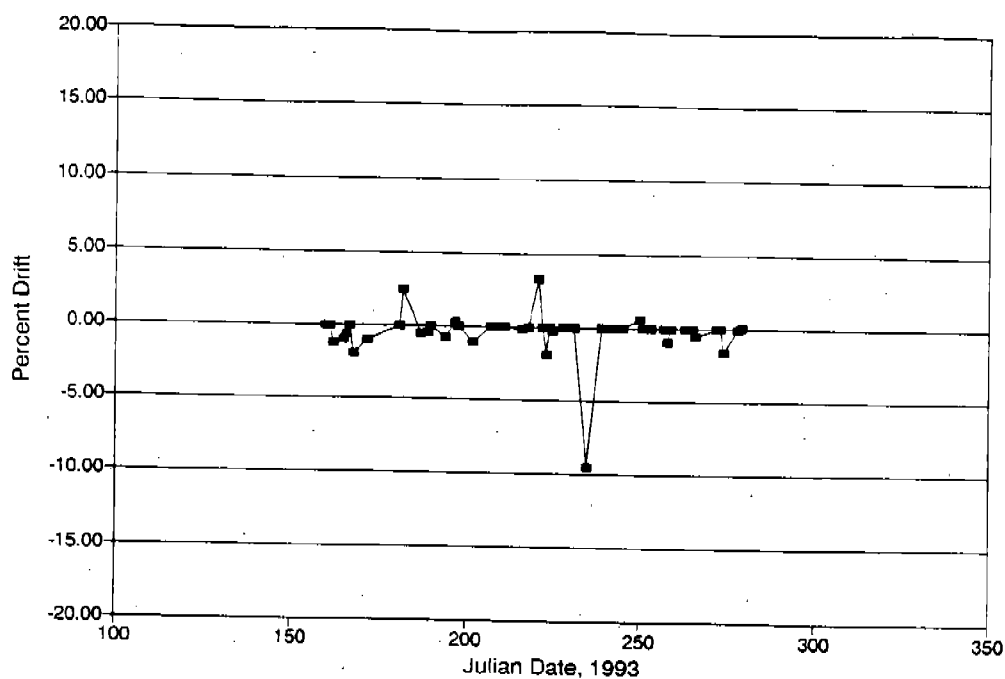
Figure 4-15. Daily Calibration Percent Drift, Channel C

DAILY CALIBRATION - PERCENT DRIFT
Radian Channel D
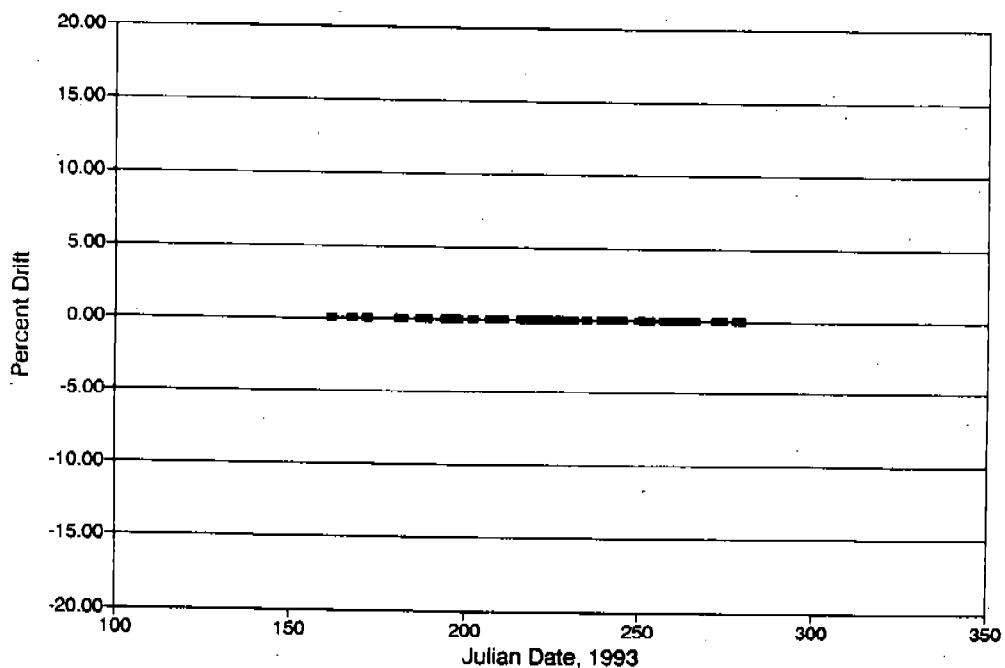
Figure 4-16. Daily Calibration Percent Drift, Channel D

4-14

Table 4-2

Summary NMOC Calibration Factor Drift Results

Radian Channel	Cases	Calibration Factor Drift ppmC/Area Count x 10^6			Percent Factor Drift			Absolute Percent Factor Drift	
		Minimum	Mean	Maximum	Minimum	Mean	Maximum	Mean	Standard Deviation
A	6	-3.9	-0.1	3.3	-1.181	-0.032	0.987	0.361	0.563
B	4	0.0	0.1	0.3	0.000	0.023	0.091	0.023	0.045
C	56	-29	-0.9	1.1	-9.568	-0.310	3.318	0.549	1.413
D	50	-10	-1.3	5.5	-3.341	-0.397	1.722	0.483	0.728
Overall	116	-29	-0.1	5.5	-9.568	-0.322	3.318	0.493	1.098

mixture whose concentration was known and was referenced to a propane NIST CRM 1666B reference standard as follows:

$$\text{calibration factor} = \frac{\text{concentration of propane standard (ppm) x 3 ppmC/ppm}}{\text{(propane standard response (area counts) – zero response (area counts))}}$$

Daily calibration factors ranged from 0.000270 ppmC/area count to 0.000344 ppmC/area count, depending on the channel. Maxima, minima, and mean values are given in Table 4-2 for calibration factor drift and percent calibration factor drift. If drift and percent drift are random variables and normally distributed, the mean values would be expected to be zero. The means shown in Table 4-2 for the drift and percent drift are approximately zero, showing little bias overall, or for any channel. The overall mean values shown in Table 4-2 were weighted according to the number of calibration drift data for each channel. The last two columns of Table 4-2 show the means and standard deviations of the absolute percent calibration factor drifts. The fact that the standard deviations are the same order of magnitude as the means indicates that the mean calibration factor drifts are not significantly different from zero.

Calibration factor drift was defined as final calibration factor for the day, minus initial calibration factor. Percent calibration factor drift was defined as the calibration factor drift divided by the initial calibration factor, expressed as a percentage. The absolute percent calibration factor drift is a measure of the calibration drift variability and averaged 0.493% overall. The mean absolute percent calibration drift ranged from 0.023% for Radian Channel B to 0.549% for Radian Channel C.

4.3   In-House QC Samples

In-house QC samples were prepared by Radian personnel by diluting dry propane with cleaned, dried air using calibrated flowmeters. The propane used for the in-house quality control samples was certified against an NIST Reference Standard. The concentration of the in-house standard ranged from approximately 0.800 ppmC to

1.326 ppmC. The analyst did not know the concentration of the in-house standard prior to analysis.

The daily in-house QC data for each Radian channel are given in Appendix G, and include:

- Calendar date analyzed;
- Julian date for 1993;
- Radian ID Number;
- Calculated NMOC concentration in ppmC;
- Measured NMOC concentration in ppmC;
- Bias (measured NMOC - calculated NMOC); and
- Percent Bias (Bias * 100 / calculated NMOC).

Because of the limited number of analyses per day, generally only two analysis channels (C and D) were used. Therefore, there are only a few data for Channels A and B.

Measured versus calculated NMOC concentrations in Figures 4-17 and 4-18 show excellent agreement. Table 4-3 summarizes the results of the linear regressions for the Radian in-house QC data, showing regression intercepts near zero, and slopes and coefficients of correlation all near 1.0.

Tables 4-4 and 4-5 give statistics for in-house QC measurements. DIFF is the ppmC difference between the measured and the calculated NMOC concentrations, and PCDIFF is the percentage of the difference relative to the calculated value. Both DIFF and PCDIFF may be considered to be bias terms, assuming that the calculated value is the correct NMOC concentration for the in-house QC sample. Overall, PCDIFF shows a mean bias of -5.971%, and ranges from -6.188% for Channel D to -5.549% for Channel C. APCDIFF, absolute value of PCDIFF, was used as a measure of precision. The absolute percent difference ranged from 5.549 for Channel C to 6.188 for Channel D and averaged 5.97 percent. These figures show excellent agreement and consistency

In-house Propane QC Results
Channel C
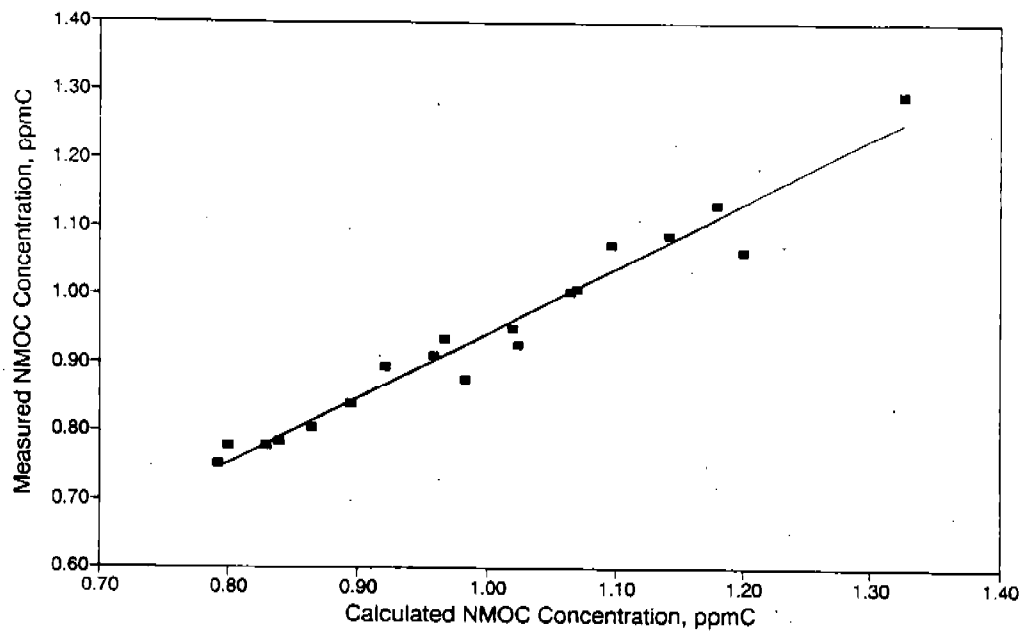
Figure 4-17. In-house Quality Control Results, Channel C

In-house Propane QC Results
Channel D
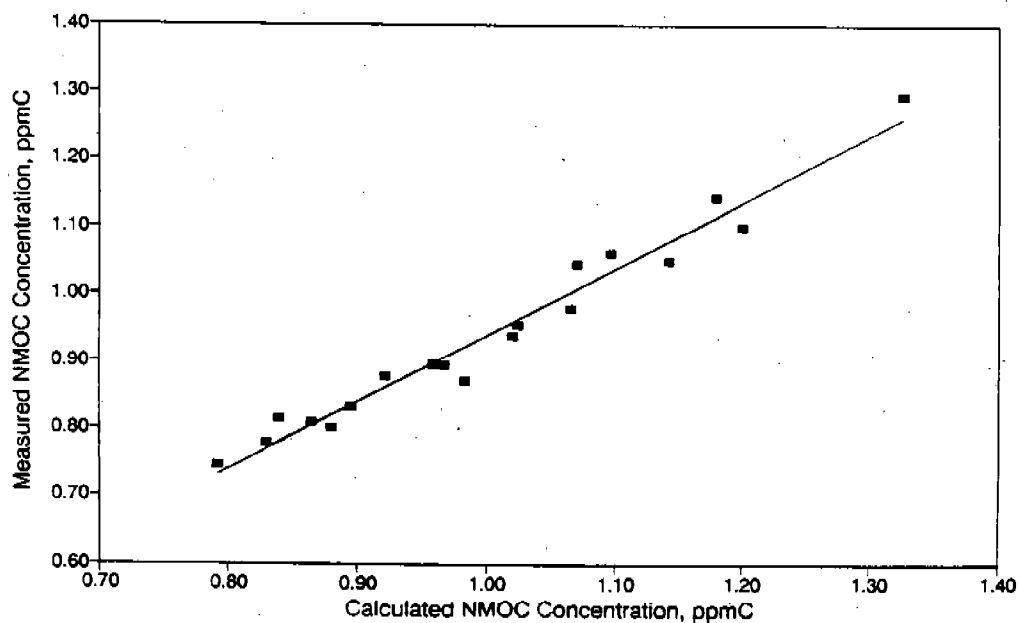
Figure 4-18. In-house Quality Control Results, Channel D

4-18

Table 4-3

Linear Regression Parameters for In-House Quality Control Data

Radian Channel[a]	Cases	Intercept	Slope	Coefficient of Correlation
C	19	-0.014	0.958	0.980
D	19	-0.051	0.989	0.984

[a]Due to the limited number of data for Channel A or B, regressions were not possible.

Table 4-4

In-House Quality Control Statistics, by Radian Channel

Statistics	Variables		
	DIFF[a]	PCDIFF[b]	APCDIFF[c]
Channel A			
Cases	2	2	2
Minimum	-0.082	-7.374	4.162
Maximum	0.041	-4.162	7.374
Mean	-0.062	-5.768	5.768
Standard Deviation	0.029	2.271	2.271
Standard Error	0.021	1.606	1.606
Skewness	.[d]	.	.
Kurtosis	.	.	.
Channel B			
Cases	1	1	1
Minimum	-0.105	-9.442	-9.442
Maximum	-0.105	-9.442	-9.442
Mean	-0.105	-9.442	-9.442
Standard Deviation	.	.	.
Standard Error	.	.	.
Skewness	.	.	.
Kurtosis	.	.	.
Channel C			
Cases	19	19	19
Minimum	-0.135	-11.250	11.250
Maximum	-0.021	-2.005	2.005
Mean	-0.056	-5.594	5.594
Standard Deviation	-0.029	2.664	2.664
Standard Error	-0.007	0.611	0.611
Skewness	-1.336	-0.731	-0.731
Kurtosis	1.940	0.080	0.080

Table 4-4

Continued

Statistics	Variables		
	DIFF[a]	PCDIFF[b]	APCDIFF[c]
Channel D			
Cases	19	19	19
Minimum	-0.112	-11.405	2.331
Maximum	-0.025	-2.336	6.188
Mean	-0.061	-6.188	6.188
Standard Deviation	-0.026	2.512	2.512
Standard Error	0.006	0.576	0.576
Skewness	-0.287	0.053	0.053
Kurtosis	-0.872	-0.476	-0.476

[a]DIFF = Measured NMOC concentration - Calculated NMOC concentration, ppmC.
[b]PCDIFF = DIFF/calculated NMOC concentration x 100.
[c]APCDIFF = Absolute value of PCDIFF.
[d] . = Calculation not possible due to limited data.

Table 4-5

Overall In-House Quality Control Statistics

Statistics	DIFF[a]	PCDIFF[b]	APCDIFF[c]
Cases	41	41	41
Minimum	-0.135	-11.405	2.005
Maximum	-0.021	-2.005	11.405
Mean	-0.060	-5.971	5.971
Standard Deviation	0.028	2.560	2.560
Standard Error	0.004	0.400	0.400
Skewness	-0.717	-0.275	0.275
Kurtosis	-0.007	-0.593	0.593

[a]DIFF = Measured NMOC concentration - Calculated NMOC concentration, ppmC.
[b]PCDIFF = DIFF/calculated NMOC concentration x 100.
[c]APCDIFF = Absolute value of PCDIFF.

for the in-house quality control data and include variability not only in the instrumental analysis but also in the apparatus and method used to generate the QC samples.

4.4   Repeated Analyses

Replicate (or repeated) analyses results are listed in Table 4-6. Repeated analyses from the contents of a canister are used to estimate analytical precision. The first analysis was performed at the Radian laboratory on the day the canister was received from the sample site, and is designated in the table by an I. The second analysis from the canister, designated by an R in the sample identification (ID) number (see Table 4-6), was performed at least 24 hours after the first analysis. This procedure was followed to ensure that sufficient time had elapsed between removal of an aliquot for analysis to allow the canister contents to equilibrate with the solid surfaces and to allow any concentration gradients within the canister to disperse.

Sample number, site code, date sampled, sample ID number, measured concentrations for Injections 1 and 2, mean NMOC concentration, analysis average concentration, canister mean, difference between replicate analyses, percent difference between replicate analyses, and absolute percent difference are given in Table 4-6. The mean concentration in Column 5, in parts per million carbon by volume (ppmC), is the arithmetic average of the NMOC concentrations for the two analyses shown in Columns 3 and 4, headed "Inj 1 and Inj 2." Column 6, labeled "Canister Mean" is the concentration for each sample number and is the average of the mean concentrations for each analysis.

Percent differences are calculated by the following equation:

$$\% \text{ Diff} = \frac{X_2 - X_1}{(X_1 + X_2) / 2} \cdot 100$$

Table 4-6

Replicate Analysis Results for the 1993 NMOC Program

Collection Date	Radian ID	Inj 1 NMOC (ppmC)	Inj 2 NMOC (ppmC)	Average NMOC (ppmC)	Canister NMOC (ppmC)	Replicates Diff	% Diff	Abs % Diff
LINY								
06/14/93	1067 I	0.196	0.194	0.195	0.189	-0.013	-6.888	6.888
06/14/93	1067 R	0.197	0.167	0.182				
07/06/93	1247 I	0.162	0.174	0.168	0.202	0.067	33.335	33.335
07/06/93	1247 R	0.235	0.236	0.235				
07/06/93	1248 I	0.238	0.245	0.241	0.239	-0.004	-1.615	1.615
07/06/93	1248 R	0.239	0.236	0.237				
07/12/93	1291 I	0.441	0.432	0.437	0.439	0.005	1.170	1.170
07/12/93	1291 R	0.443	0.441	0.442				
07/14/93	1308 I	0.253	0.263	0.258	0.296	0.075	25.469	25.469
07/14/93	1308 R	0.335	0.332	0.333				
07/14/93	1309 I	0.353	0.351	0.352	0.338	-0.028	-8.254	8.254
07/14/93	1309 R	0.311	0.337	0.324				
08/10/93	1559 I	0.434	0.430	0.432	0.436	0.009	2.000	2.000
08/10/93	1559 R	0.437	0.445	0.441				
08/10/93	1560 I	0.488	0.500	0.494	0.462	-0.062	-13.460	13.460
08/10/93	1560 R	0.431	0.432	0.431				
09/17/93	1946 I	0.196	0.200	0.198	0.204	0.011	5.405	5.405
09/17/93	1946 R	0.226	0.192	0.209				
09/17/93	1947 I	0.190	0.175	0.182	0.172	-0.020	-11.628	11.628
09/17/93	1947 R	0.154	0.170	0.162				
NWNJ								
06/29/93	1220 I	0.260	0.230	0.245	0.253	0.016	6.298	6.298
06/29/93	1220 R	0.267	0.254	0.261				
08/24/93	1712 I	0.443	0.445	0.444	0.449	0.009	2.030	2.030
08/24/93	1712 R	0.458	0.449	0.453				
08/24/93	1713 I	0.444	0.429	0.437	0.396	-0.082	-20.651	20.651
08/24/93	1713 R	0.351	0.360	0.355				

Table 4-6

Continued

Collection Date	Radian ID	Inj 1 NMOC (ppmC)	Inj 2 NMOC (ppmC)	Average NMOC (ppmC)	Canister NMOC (ppmC)	Replicates Diff	Replicates % Diff	Replicates Abs % Diff
P2PA								
07/21/93	1405 I	0.105	0.073	0.089	0.077	-0.024	-30.612	30.612
07/21/93	1405 R	0.067	0.063	0.065				
PLNJ								
06/21/93	1123 I	0.189	0.194	0.192	0.216	0.049	22.599	22.599
06/21/93	1123 R	0.239	0.242	0.241				
06/28/93	1192 I	0.328	0.298	0.313	0.297	-0.032	-10.769	10.769
06/28/93	1192 R	0.282	0.279	0.281				
06/28/93	1193 I	0.297	0.297	0.297	0.206	-0.181	-87.656	87.656
06/28/93	1193 R	0.111	0.121	0.116				
07/07/93	1275 I	0.246	0.246	0.246	0.279	0.065	23.340	23.340
07/07/93	1275 R	0.310	0.312	0.311				
07/16/93	1357 I	0.119	0.111	0.115	0.082	-0.066	-80.869	80.869
07/16/93	1357 R	0.046	0.052	0.049				
07/16/93	1358 I	0.193	0.172	0.182	0.125	-0.116	-92.731	92.731
07/16/93	1358 R	0.079	0.054	0.067				
08/25/93	1735 I	0.352	0.350	0.351	0.405	0.108	26.619	26.619
08/25/93	1735 R	0.478	0.438	0.458				
08/25/93	1736 I	0.410	0.420	0.415	0.377	-0.076	-20.132	20.132
08/25/93	1736 R	0.339	0.339	0.339				
08/27/93	1751 I	1.790	1.759	1.775	1.754	-0.042	-2.376	2.376
08/27/93	1751 R	1.722	1.743	1.733				
09/30/93	2044 I	0.442	0.410	0.426	0.437	0.022	5.034	5.034
09/30/93	2044 R	0.432	0.461	0.448				
				Count	24	24	24	24
				Average	0.347	-0.013	-9.764	22.539
				Standard Deviation	0.322	0.065	33.935	26.851

4-25

where:

$\overline{X}_1$ = The mean NMOC concentration for the first analysis; and

$\overline{X}_2$ = The mean NMOC concentration for the second (or repeated) analysis.

A total of 48 analyses on 24 canister samples are shown in Table 4-6. The percent difference ranged from -92.731 to +33.355 and averaged -9.764 overall. The low value of the overall average percent difference indicated that there was an insignificant average bias between the second and the first analyses.

The final column in Table 4-6 lists absolute percent difference. The overall absolute percent difference was 22.54 for 1993. In 1992, the average absolute percent difference was 21.61, 14.29 in 1991, 7.59 in 1990, and 8.24 in 1989. Experience has shown that in general the lower the concentration, the higher the percent difference, and especially the absolute percent difference.

4.5   Duplicate Sample Results

Duplicate analysis results are given in Table 4-7. Percent differences (between the canister means) ranged from -36.520 to +41.753 and averaged +0.479 overall. The low overall average percent difference indicates that there was no systematic bias between samples. The absolute percent difference averaged 12.633. Absolute percent differences averaged 15.626 in 1992, 15.768 in 1991, 7.594 in 1990, and 10.621 in 1989.

4.6   Canister Pressure Results

Canister pressure results for the NMOC monitoring program are an important gauge to assess whether the ambient air samples obtained are representative. The NMOC sampling systems are designed to obtain an integrated ambient air sample between 6:00 a.m. and 9:00 a.m. local time, or at other programmed intervals. Canister pressures are measured to obtain a better understanding of the range and magnitude of

Table 4-7

Duplicate Samples for the 1993 NMOC Program

Collection Date	Radian ID	Injection 1 NMOC (ppmC)	Injection 2 NMOC (ppmC)	Average NMOC (ppmC)	Canister NMOC (ppmC)	Duplicates Diff	% Diff	Abs % Diff
LINY								
06/14/93	1067	0.196	0.194	0.195	0.189	0.029	14.467	14.467
06/14/93	1067	0.197	0.167	0.182				
06/14/93	1068	0.221	0.215	0.218	0.218			
06/24/93	1172	0.229	0.230	0.229	0.229	0.024	9.753	9.753
06/24/93	1173	0.241	0.265	0.253	0.253			
07/06/93	1247	0.162	0.174	0.168	0.202	0.038	17.083	17.083
07/06/93	1247	0.235	0.236	0.235				
07/06/93	1248	0.238	0.245	0.241	0.239			
07/06/93	1248	0.239	0.236	0.237				
07/14/93	1308	0.253	0.263	0.258	0.296	0.042	13.345	13.345
07/14/93	1308	0.335	0.332	0.333				
07/14/93	1309	0.353	0.351	0.352	0.338			
07/14/93	1309	0.311	0.337	0.324				
08/10/93	1559	0.434	0.430	0.432	0.436	0.026	5.825	5.825
08/10/93	1559	0.437	0.445	0.441				
08/10/93	1560	0.488	0.500	0.494	0.462			
08/10/93	1560	0.431	0.432	0.431				
08/23/93	1716	0.891	0.851	0.871	0.871	-0.035	-4.055	4.055
08/23/93	1717	0.842	0.831	0.836	0.836			
09/08/93	1828	0.148	0.142	0.145	0.145	0.001	0.687	0.687
09/08/93	1829	0.147	0.145	0.146	0.146			
09/17/93	1946	0.196	0.200	0.198	0.204	-0.032	-16.778	16.778
09/17/93	1946	0.226	0.192	0.209				
09/17/93	1947	0.190	0.175	0.182	0.172			
09/17/93	1947	0.154	0.170	0.162				
09/30/93	2052	0.246	0.266	0.256	0.256	0.013	4.952	4.952
09/30/93	2053	0.26	0.278	0.269	0.269			

Table 4-7

Continued

Collection Date	Radian ID	Injection 1 NMOC (ppmC)	Injection 2 NMOC (ppmC)	Average NMOC (ppmC)	Canister NMOC (ppmC)	Duplicates		
						Diff	% Diff	Abs % Diff
NWNJ								
06/15/93	1078	0.386	0.393	0.389	0.389	0.017	4.392	4.392
06/15/93	1079	0.410	0.404	0.407	0.407			
06/25/93	1184	0.337	0.337	0.337	0.337	0.100	25.949	25.949
06/25/93	1185	0.457	0.418	0.437	0.437			
07/07/93	1264	0.387	0.399	0.393	0.393	-0.083	-23.651	23.651
07/07/93	1265	0.312	0.308	0.310	0.310			
07/15/93	1327	0.239	0.234	0.236	0.236	-0.046	-21.741	21.741
07/15/93	1328	0.186	0.194	0.190	0.190			
08/11/93	1589	0.522	0.536	0.529	0.529	0.059	10.638	10.638
08/11/93	1590	0.587	0.589	0.588	0.588			
08/24/93	1712	0.443	0.445	0.444	0.449	-0.053	-12.464	12.464
08/24/93	1712	0.458	0.449	0.453				
08/24/93	1713	0.444	0.429	0.437	0.396			
08/24/93	1713	0.351	0.360	0.355				
09/08/93	1839	0.284	0.284	0.284	0.284	0.000	0.000	0.000
09/08/93	1840	0.284	0.283	0.284	0.284			
09/17/93	1930	0.119	0.154	0.137	0.137	-0.001	-0.733	0.733
09/17/93	1931	0.143	0.129	0.136	0.136			
P1PA								
08/18/93	1644	0.115	0.123	0.119	0.119	-0.003	-2.251	2.251
08/18/93	1645	0.120	0.113	0.116	0.116			
09/21/93	1965	0.157	0.161	0.159	0.159	-0.049	-36.520	36.520
09/21/93	1966	0.112	0.108	0.110	0.110			
P2PA								
07/21/93	1405	0.105	0.073	0.089	0.077	0.006	7.157	7.157
07/21/93	1405	0.067	0.063	0.065				
07/21/93	1406	0.082	0.083	0.083	0.083			

Table 4-7

Continued

Collection Date	Radian ID	Injection 1 NMOC (ppmC)	Injection 2 NMOC (ppmC)	Average NMOC (ppmC)	Canister NMOC (ppmC)	Duplicates		
						Diff	% Diff	Abs % Diff
09/09/93	1870	0.325	0.289	0.307	0.307	0.024	7.524	7.524
09/09/93	1871	0.332	0.330	0.331	0.331			
PLNJ								
06/28/93	1192	0.328	0.298	0.313	0.297	-0.091	-35.985	35.985
06/28/93	1192	0.282	0.279	0.281				
06/28/93	1193	0.297	0.297	0.297	0.206			
06/28/93	1193	0.111	0.121	0.116				
07/16/93	1357	0.119	0.111	0.115	0.082	0.043	41.753	41.753
07/16/93	1357	0.046	0.052	0.049				
07/16/93	1358	0.193	0.172	0.182	0.125			
07/16/93	1358	0.079	0.054	0.067				
08/12/93	1582	0.591	0.578	0.584	0.584	0.095	15.022	15.022
08/12/93	1583	0.695	0.662	0.679	0.679			
08/25/93	1735	0.352	0.350	0.351	0.405	-0.028	-7.087	7.087
08/25/93	1735	0.478	0.438	0.458				
08/25/93	1736	0.410	0.420	0.415	0.377			
08/25/93	1736	0.339	0.339	0.339				
09/10/93	1900	0.437	0.457	0.447	0.447	0.023	5.016	5.016
09/10/93	1901	0.476	0.463	0.470	0.470			
09/21/93	1942	0.586	0.569	0.578	0.578	-0.033	-5.877	5.877
09/21/93	1943	0.530	0.558	0.545	0.545			
09/30/93	2044	0.442	0.410	0.426	0.437	-0.013	-3.020	3.020
09/30/93	2044	0.432	0.461	0.448				
09/30/93	2045	0.424	0.424	0.424	0.424			
					Count	56	28	28	28
					Average	0.325	0.0033	0.4794	12.633
					Standard Deviation	0.181	0.046	17.157	11.363

pressures being generated by the NMOC sampling systems and to assess possible canister leakage. Canister pressure data are given in Table 4-8 for both single canister samples and duplicate samples. The pressures reported in Table 4-8 are the canister sampling pressures measured immediately before analysis in the laboratory. A significant decrease between the field sampling pressure and the laboratory value might indicate a leak.

All sample canisters averaged 14.2 psig, while duplicate samples averaged 15.8 psig. The column entitled "All Samples" includes pressures from both single samples and duplicate samples. Standard deviations were 2.9 and 3.3 psig, respectively. These results indicate reproducible positive pressures, reasonably consistent operation of the samplers, and consistent performance of the samplers.

4.7   Canister Cleanup Results

Prior to the start of the 1993 NMOC monitoring program all of the canisters were cleaned and analyzed for their NMOC content to establish canister initial conditions. The resulting analysis with cleaned, dried air that had been humidified averaged 0.0050 ppmC, ranging from 0.0000 to 0.0200 ppmC. Any canisters that produced more than 0.020 ppmC were recleaned.

Continual monitoring of canister cleanup was important to ensure that there was negligible carryover from one site sample to the next. The daily canister cleanup procedure was described in detail in Section 3.4. If the NMOC content was below 0.020 ppmC, cleanup was considered to be satisfactory.

Average percent recoveries, or average percent cleanup, in 1993 averaged 98.76% (98.79% in 1992, 99.75% in 1991, 99.75% in 1990, 99.74% in 1989, 99.69% in 1988, 99.37% in 1987, 99.89% in 1986, and 99.90% in 1985). The reported average percent recovery is based on average NMOC concentration and average cleanup concentration.

Table 4-8

NMOC Pressure[a] Statistics

Statistics	All Samples	Duplicate Sample Canisters
Number of Cases	314	56
Minimum Pressure, psig	6.0	8.0
Maximum Pressure, psig	21.0	20.0
Mean Pressure, psig	14.2	15.8
Median Pressure, psig	14.0	16.5
Standard Deviation, psig	2.9	3.3
Skewness, psig	0.07	0.67
Kurtosis, psig	-0.02	-0.35

[a]Measured immediately prior to analysis.

The reported percent cleanup figures should be considered minimum values. The actual percent cleanup was greater than the reported values because, after the percent cleanup was measured, the canister was evacuated a third time before being shipped to the site.

4.8   External Audit Results

Primary measures of accuracy for the NMOC monitoring data were calculated from the results of the analysis of propane audit samples provided by the EPA. Results are reported in terms of percent bias relative to the EPA concentration spiked.

Two audit samples, ID 1863 and 1864, were analyzed during the NMOC program. The EPA Audit Report is given in Appendix I. Table 4-9 gives the concentrations reported by the four Radian channels. The theoretical concentration reported in Table 4-9 was calculated using dilution factors estimated when the audit samples were prepared by the EPA Auditor. The percent bias results are presented in Table 4-10 and were calculated relative to the theoretical values. The Radian bias ranged from +1.79% to +8.48%, and averaged +4.13% for the audit canisters.

4.9   Data Validation

Secondary backup disks were updated daily on 20 megabyte hard disks. At the completion of the sampling and analysis phase, 10% of the data base was checked to verify its validity. Items checked included original data sheets, checks of all the calculations, and data transfers. In making the calculations for the final report and other reports, corrections were made to the data base as errors or omissions were encountered.

A total of 414 NMOC concentration measurements were performed by Radian from June through October 1993. This included 341 sample analyses, 24 repeated analyses, 41 in-house QC analyses (on 19 in-house QC samples), and 2 audit samples (x 4 analyses each).

Table 4-9

NMOC External Audit Sample Results

ID Number	Theoretical	Concentration, ppmC			
		Analysis			
		Radian A	Radian B	Radian C	Radian D
1863	1.12	1.180	1.140	1.160	1.160
1864	0.66	0.685	0.716	0.690	0.673

Table 4-10

Bias of Audit Samples from Theoretical Concentrations

ID Number	Theoretical Concentration, ppmC	Percent Difference from Theoretical			
		Radian A	Radian B	Radian C	Radian D
1863	1.12	5.357	1.786	3.571	3.571
1864	0.66	3.788	8.485	4.545	1.970

Percent Difference = (Analysis Channel - Theoretical) / Theoretical * 100

Ten percent of the data base was validated according to the procedure outlined below.

- Calibration factors were checked.

    -- The area count from the strip chart that was used to determine the calibration factor was examined to verify that the data had been properly transferred to the calibration form.

    -- The calibration form was examined to verify that the calculations had been correctly made.

    -- Each datum on the disk was compared to the corresponding datum on the calibration sheet for accuracy.

- Analysis data were checked.

    -- Area counts were verified from the appropriate strip chart.

    -- Calculations were reverified on the analysis forms.

    -- Each datum on the disk was compared to the corresponding item on the analysis form.

- Field data sheet was checked.

    -- Each datum on the disk was compared to the corresponding datum on the field data sheet.

The error rate was calculated in terms of the number of items transferred from the original data sources. For each NMOC value in the 1993 data set, 36 items were transferred from original sources to the magnetic disks. In the data validation study each item on the disk was compared with the corresponding value on the original source of data. One error was found (and corrected) for an expected error percentage of 0.007 percent.

Each time the data file was opened and a suspected error found, the error was checked against the original archived documents, and corrected where appropriate.

4.10 NMOC Monitoring Program Records

The QA records developed by Radian for this project are extensive and will be preserved as archives. One of the most important objectives of the study was to develop a data base that is well planned and documented and contains NMOC data of known and verifiable quality. Achieving that objective has involved keeping and preserving a number of records that trace the project from planning through reporting.

4.10.1 Archives

In order to keep detailed records that document the quality of the measurements made, Radian developed the following material:

- Quality Assurance Project Plan (QAPP);

- Notebooks;

- Field data sheets;

- Laboratory calibration sheets;

- Laboratory analysis sheets;

- Chromatographic strip charts;

- Bi-weekly, monthly reports to the EPA;

- Memoranda and correspondence; and

- Final report.

In addition to the above items, any papers to be presented at technical meetings and symposia and published in technical journals will be added to the archives.

The QAPP[2] was the Quality Assurance Project Plan and the workplan. The QAPP was designed according to the EPA Quality Assurance Guidelines and set the

pattern of steps necessary to document and control the quality of the data obtained throughout the study.

Several notebooks were necessary to maintain day-to-day records of the project. Field and laboratory data sheets were designed in advance, so that the data recorded appeared in a logical sequence and filled in blanks on the sheet. Additional space was provided for other comments. Each NMOC analysis was assigned a unique Radian Identification Number. Field data sheets and shipping records accompanied the canisters in transit.

4.10.2 Magnetic Disks

In order to manage the data base for report generation and data analysis, pertinent data from the various data sheets and notebooks were transferred to 20 megabyte magnetic disks. The following software were used in the construction of the data base: Paradox 3.5®, QUATTRO®, and Freelance®. Statistical calculations were performed using SAS® and SYSTAT® software. The data access is rapid and in a convenient form. The primary 20 megabyte magnetic disk has three backup disks.

5.0 NMOC DATA ANALYSIS AND CHARACTERIZATION

The purpose of this section is to characterize the NMOC data qualitatively as well as quantitatively. The NMOC data are shown to fit a two-parameter lognormal distribution better than a normal Gaussian distribution. The summary NMOC data for the sites of the 1993 study are given in Appendix C.

5.1   Overall Characterization

Figure 5-1 gives a stem-and-leaf plot of the 1993 NMOC data along with statistics for NMOC. The stem-and-leaf plots show the actual NMOC concentrations truncated to two or three decimal points. The digits to the left of the vertical open space are called stems and the digits to the right of the open space are the leaves. The data are sorted from the smallest at the top of the graph to the largest at the bottom of the graph. The minimum NMOC value measured was 0.059 ppmC and is shown as "0   5" on the first row at the top of the plot. The maximum NMOC concentration measured was 5.749 shown as "57   4" in the bottom row of the chart. The plot shows 367 leaves, one for each NMOC site datum in the 1993 program. The H's in the open vertical space locate the stem and leaf for the upper and lower hinges, and the M locates the stem and leaf for the median. The median separates the sorted NMOC concentrations into two equal halves; the hinges (or quartiles) separate each half into halves. The "H spread" or interquartile range is the difference between the NMOC values of the two hinges.

Statistics shown for NMOC are number of cases, minimum, maximum, mean, median, standard deviation, standard error, skewness, kurtosis, and the two hinges. Each NMOC determination is the average of two or three injections of the site samples. In the case of replicates, each NMOC determination is the average of the original and repeated analysis concentrations. In the case of duplicates, the NMOC sample determinations were averaged to represent the NMOC concentration for the sample date.

```
 0    56667 78889
 1    00001 12223 33333 33444 4444
 1    55555 55666 66666 66777 77778 88888 88899 99999 9999
 2 H  00000 01111 11111 12222 22222 23333 33333 44444 4444
 2 M  55555 55566 66666 66666 77777 88888 88999 99
 3    00000 00111 12233 33344 444
 3    55556 66666 67778 88999 99999
 4    00112 22234 444
 4 H  55555 55666 67888 89
 5    00001 11223 44
 5    55666 7889
 6    00001 2222 334
 6    66777 8999
 7    00023
 7    56677 889
 8    01223 4
 8    57
 9    59
10    6678
11    57
14    45
17    5
40    7
57    4
```

NMOC, ppmC	
Cases	313
Minimum	0.059
Maximum	5.749
Mean	0.404
Standard Deviation	0.445
Standard Error	0.025
Skewness	7.644
Kurtosis	80.607
Lower Hinge (H)	0.200
Median (M)	0.298
Upper Hinge (H)	0.486

Figure 5-1. Stem-and-leaf Plot of the 1993 NMOC Data

The standard error is the standard deviation divided by the square root of the number of cases. Positive skewness is a third moment about the mean value, and characterizes a tail to the right of the mean value. A normal Gaussian distribution has a skewness of zero. The skewness of 7.644 for the 1993 NMOC data suggests a nonnormal frequency distribution. Kurtosis is the fourth moment about the mean and relates to the pointedness of the distribution. A distribution more pointed than a normal distribution, having the same standard deviation, has a kurtosis greater than 3.0. The numerical values of kurtosis listed in this report are zero centered. That is, 3.0 has been subtracted from the fourth moment to give 0.0 for a distribution shaped similar to a normal distribution.

Figure 5-2 is a stem-and-leaf plot of the 1993 ln(NMOC) data. The plot shows an approximately symmetrical distribution (skewness = 0.410). The kurtosis equal to 1.195 indicates the ln(NMOC) distribution to be slightly more pointed than a normal distribution.

The shape of the stem-and-leaf plots suggests a lognormal distribution. Figures 5-3 and 5-4 support the lognormal distribution hypothesis for NMOC. The vertical scales in Figures 5-3 and 5-4 are arranged so that if the cumulative frequency of occurrence of NMOC were normally distributed, the points would plot into a straight line. The line in Figure 5-3 has a noticeable concave downward trend, indicating that the data do not fit a normal distribution well. Figure 5-4 plots the logarithm of NMOC on the same vertical scale. The fact that the squares on the graph plot into approximately a straight line supports the hypothesis that the NMOC data are approximately lognormally distributed. A solid square on the graph indicates the location of a single datum. The results, although qualitative, show a dramatic difference between the normal and lognormal hypotheses, and suggest that the latter more nearly describes the NMOC data.

```
-2     88
-2     766
-2     54444
-2     3222
-2     11100 00000 0
-1     99999 99998 88888 88888 888
-1 H   77777 77777 66666 66666 66666 66666 66
-1     55555 55555 55555 55544 44444 44444 44444 44444 4
-1 M   33333 33333 33333 33333 33222 22222 22222 2222
-1     11111 11111 11111 00000 00000 00000
-0     99999 99999 99999 99988 88888 88888 8
-0 H   77777 77777 77777 76666 66666 666
-0     55555 55555 54444 44444 444
-0     33333 33333 33222 22222 22
-0     11111 100
 0     00001 1
 0     33
 0     5
 1     47
```

LNMOC, In(ppmC)	
Cases	313
Minimum	-2.830
Maximum	1.749
Mean	-1.160
Standard Deviation	0.661
Standard Error	0.037
Skewness	0.410
Kurtosis	1.195
Lower Hinge (H)	-1.609
Median (M)	-1.211
Upper Hinge (H)	-0.722

Figure 5-2. Stem-and-leaf of the Ln(NMOC) Data
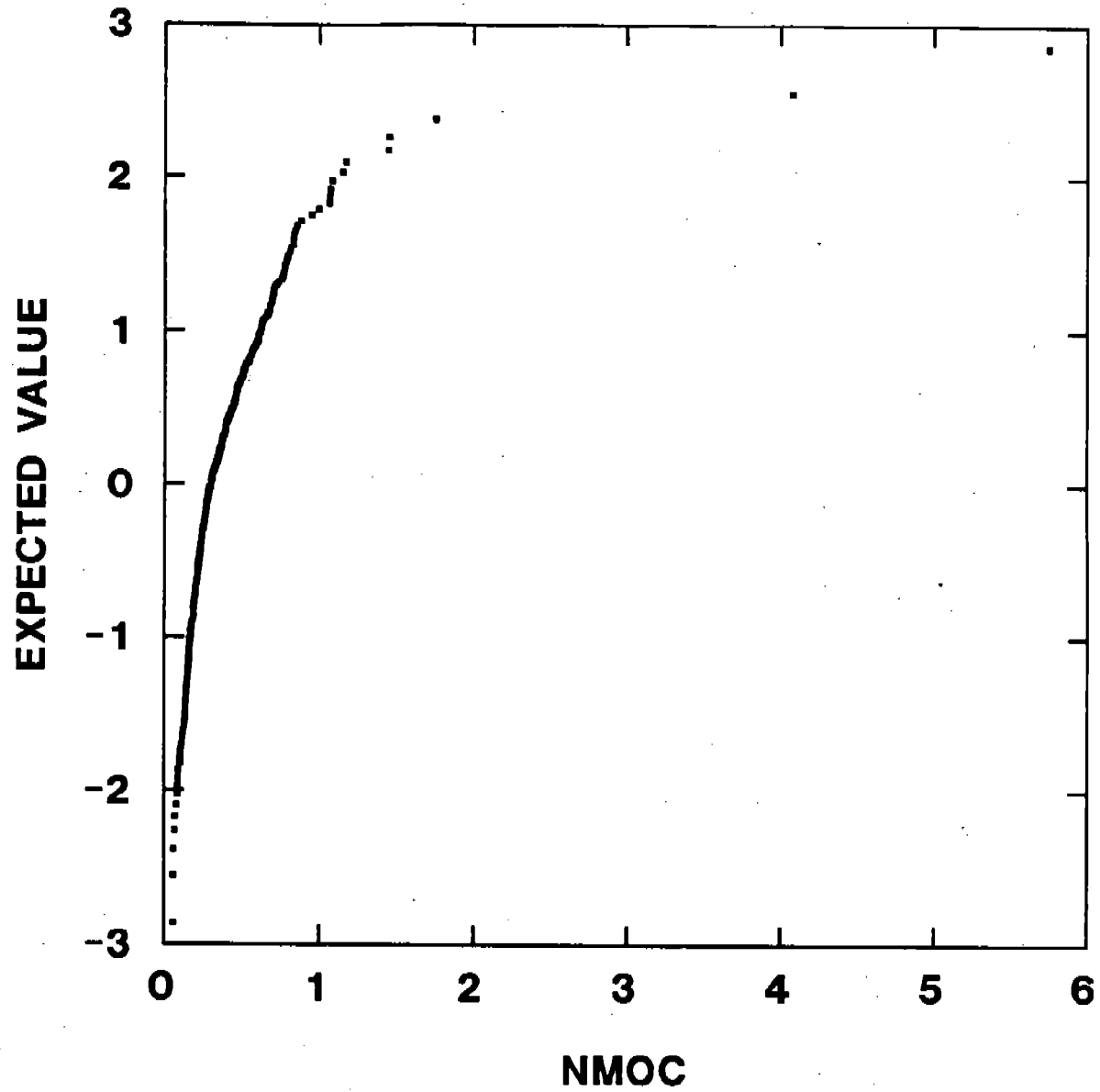
Figure 5-3. Cumulative Frequency Distribution for the 1993 NMOC Data
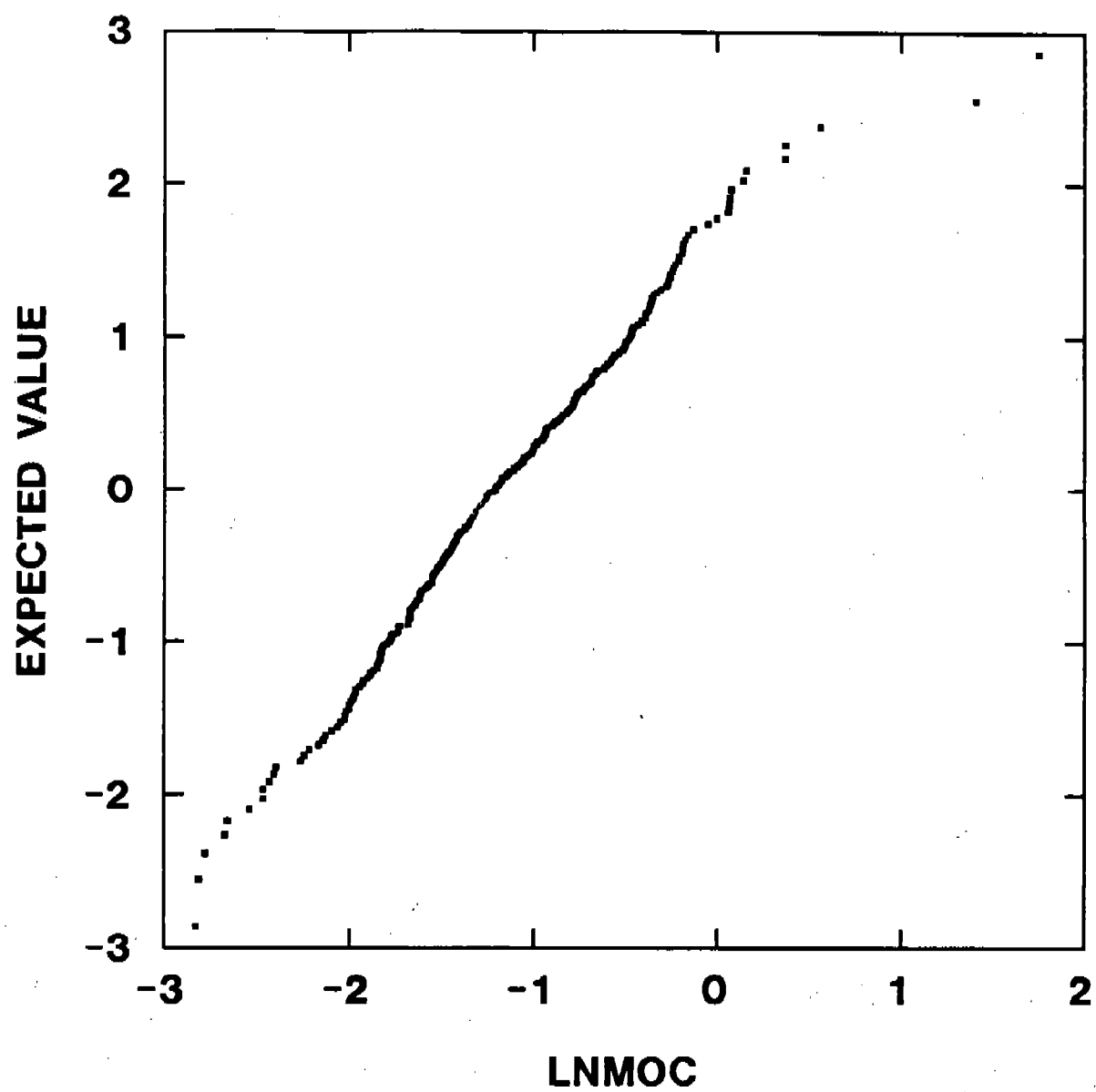
Figure 5-4. Cumulative Frequency Distribution for the 1993 Ln(NMOC) Data

5.2 Monthly Variations, 1993

Table 5-1 partitions the NMOC data for the summer of 1993 into groups that correspond to monthly intervals. For the summer of 1993, the monthly means and medians of the NMOC sites for June, July, August, and September parallel one another. That is, the NMOC mean and median concentrations for July 1993 are less than the mean and median for June 1993. Means and median for August show dramatic increases compared to July 1993. The mean and median for September are less than the mean and median for August 1993, but greater than the mean and median for July 1993. Arithmetic means are used in Table 5-1 in spite of the observations given previously in Section 5.1 which conclude that the frequency distribution of NMOC concentrations in ambient air are approximately logarithmic normal distributed. Table 5-1 also gives monthly minima, medians, and maxima which are independent of the probability distribution from which they are derived.

Table 5-1

Summary Statistics for 1993 NMOC Sites, by Month

| Sample Month 1993 | NMOC Concentration, ppmC | | | | | Cases |
	Minimum	Median	Mean	Maximum	Standard Deviation	
June	0.069	0.260	0.336	1.171	0.201	62
July	0.085	0.246	0.272	0.694	0.125	80
August	0.088	0.471	0.612	5.749	0.739	89
September	0.059	0.279	0.356	1.150	0.233	82

6.0 THREE-HOUR AIR TOXICS DATA SUMMARY

The 1993 NMOC program included 3-hour air toxics sample collection at seven NMOC sites (see Table 6-1) located in the contiguous United States. Overall concentration results are reported in ppbv in Section 6.1, and site-specific results are given in Section 6.2.

Analyses were performed using a GC/MD system incorporating a FID, photoionization detection (PID), and electron capture detection (ECD). Compound identifications were made using a combination of retention time ratios for PID/FID and/or ECD/FID responses, and analyst's experience and judgement. Quantitation was done using the FID response, with the exception of halogenated compounds that were quantitated using the ECD. If there was an indication that the quantitation detector response for the target compound had interference from a known or unknown source, quantitation was performed on one of the alternate detectors, if possible. Propylene was quantitated from the PID since the FID has interference a peak (propane) that coelutes with this compound. Table 6-1 indicates the number of 3-hour samples taken for GC/MD analyses to speciate for 38 air toxic compounds. Ten analyses were performed on samples from a given site. One duplicate sample was collected from each site, and the analysis of one of the samples from each site was repeated. One of the samples from each site was analyzed by GC/MS for confirmation of compound identification.

Three-hour air toxics samples were regular NMOC or SNMOC Monitoring Program samples that were collected in 6-L stainless steel canisters from 6:00 a.m. to 9:00 a.m. local time. The final canister pressure was approximately 15 psig. The samples that were speciated by GC/MD were selected at random during the summer. Each selected sample was first analyzed by the PDFID method for its total NMOC concentration or by the SNMOC method for its speciated target compound concentrations. Then the canister pressure was bled to atmospheric pressure and the canister bellows valve was closed. The canister was allowed to equilibrate at least 18 hours before the GC/MD analysis was performed.

Table 6-1

Three-Hour Ambient Air Samples and Analyses

| Site Code | Ambient Air Samples | GC/MD Analyses | | | GC/MS Analyses |
		Duplicate Canister	Replicate Analysis	Total	
B1AL	8	1	1	10	1
B2AL	8	1	1	10	1
B3AL	8	1	1	10	1
NWNJ	8	1	1	10	1
PLNH	8	1	1	10	1
P1PA	8	1	1	10	1
P2PA	8	1	1	10	1
Total	56	7	7	70	7

6.1 Overall Results

Concentrations of the air toxic compounds detected are summarized in Table 6-2 for the 1993 three-hour ambient air samples that were speciated. The table shows the number of cases (samples), the percent of cases in which the compound was identified, the minimum, maximum, and mean (arithmetic average) concentration of the compound in ppbv. In cases where duplicate samples were taken, or replicate analyses were performed, the results of all the analyses were averaged for each sample. The mean refers to the daily sample averages, not the averages of all the analyses. The frequency of occurrence of target compounds fall into four prominent percentile categories:

- Those occurring in more than 89% of the samples tested;

- Those occurring from 60% to 66% of the samples tested;

- Those occurring in less than 35% of the samples tested; and

- Those not identified in any of the 3-hour air samples.

These results are summarized in Table 6-3.

The overall concentration ranged from 0.01 ppbv for tetrachloroethylene to 15.18 ppbv for toluene. Chloroprene was present but not quantitated due to an interference peak on both the FID and PID. Acetylene was not quantitated due to interference peaks on the FID.

6.2 Site Results

Tables 6-4 through 6-10 give 3-hour ambient air concentrations by site code for the 38 air toxics target compounds. The site mean individual target compound concentration, averaged over all target compounds, ranges from 0.269 ppbv for B2AL to 1.278 for PLNJ. Appendix H contains the tabulations of the complete analytical results and includes the NMOC concentrations for each of the 3-hour air toxics samples.

Table 6-2
Air Toxics Compound Identifications Summary for All Sites - 1993

Compound	Cases[a] Number	Cases[a] Percent[b] Frequency	Minimum (ppbv)	Maximum (ppbv)	Mean[c] (ppbv)	Mean[c] ($\mu g/m^3$)	Mean[d] (ppbv)	Mean[e] (ppbv)
Propylene	51	91.07	0.08	11.03	1.82	3.19	1.66	1.66
Chloromethane	6	10.71	0.42	0.79	0.61	1.27	0.15	0.06
1,3-Butadiene	20	35.71	0.03	0.31	0.12	0.27	0.07	0.04
Methylene chloride	4	7.14	0.52	3.28	2.41	8.52	0.22	0.17
Chloroform	56	100.00	0.02	0.28	0.07	0.36	0.07	0.07
1,1,1-Trichloroethane	56	100.00	0.26	4.24	1.01	5.63	1.01	1.01
Benzene	56	100.00	0.09	3.09	0.64	2.08	0.64	0.64
Carbon tetrachloride	56	100.00	0.20	0.46	0.30	1.91	0.30	0.30
Trichloroethylene	6	10.71	0.19	0.61	0.41	2.21	0.05	0.04
Toluene	56	100.00	0.16	15.18	2.41	9.24	2.41	2.41
n-Octane	37	66.07	0.02	0.57	0.09	0.41	0.06	0.06
Tetrachloroethylene	56	100.00	0.01	1.82	0.24	1.67	0.24	0.24
Chlorobenzene	4	7.14	0.02	0.05	0.04	0.18	0.01	0.00
Ethylbenzene	52	92.86	0.02	1.67	0.30	1.31	0.28	0.28
m/p-Xylene/Bromoform	56	100.00	0.09	8.41	1.35	26.06	1.35	1.35
Styrene	34	60.71	0.02	0.55	0.13	0.55	0.08	0.08
o-Xylene/1,1,2,2-Tetrachloroethane	50	89.29	0.06	3.92	0.75	8.54	0.67	0.67
m-Dichlorobenzene	1	1.79	0.52	0.52	0.52	3.18	0.02	0.01
p-Dichlorobenzene	8	14.29	0.10	0.43	0.21	1.31	0.07	0.03
o-Dichlorobenzene	6	10.71	0.06	0.27	0.15	0.91	0.02	0.02

[a] A total of 56 samples were collected and analyzed by GC/MD.
[b] The percent of the total in which the compound was identified.
[c] The arithmetic average concentration of all the compound identification cases.
[d] The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[e] The arithmetic average concentration of all the sample cases using zero for compounds not detected.

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Table 6-3

1993 Air Toxic Compounds Frequency of Occurance

Frequency of Occurrence Range (%)	Target Compounds	
89 to 100	Propylene Chloroform 1,1,1-Trichloroethane Benzene Carbon tetrachloride	Tetrachloroethylene Ethylbenzene m/p-Xylene/Bromoform o-Xylene/1,1,2,2-Tetrachloroethane Toluene
60 to 66	Styrene	n-Octane
>0 to 35	1,3-Butadiene Chloromethane Methylene chloride Trichloroethylene	m-Dichlorobenzene p-Dichlorobenzene o-Dichlorobenzene Chlorobenzene
Zero	Acetylene[a] Vinyl chloride Bromomethane Chloroprene[a] Bromochloromethane	Bromodichloromethane cis-1,3-Dichloropropylene trans-1,3-Dichloropropylene 1,1,2-Trichloroethane Dibromochloromethane

[a]Not quantitated due to interference peaks.

Table 6-4

Air Toxics Compound Identifications Summary for B1AL - 1993

Compound	Cases[a]	Minimum (pptv)	Maximum (pptv)	Mean[b] (pptv)	Mean[b] (µg/m³)	Mean[c] (pptv)	Mean[d] (pptv)
Propylene	8	0.46	3.54	1.38	2.41	1.38	1.38
1,3-Butadiene	3	0.04	0.30	0.15	0.33	0.09	0.06
Chloroform	8	0.03	0.09	0.06	0.28	0.06	0.06
1,1,1-Trichloroethane	8	0.30	0.71	0.44	2.46	0.44	0.44
Benzene	8	0.21	2.63	0.87	2.84	0.87	0.87
Carbon tetrachloride	8	0.22	0.37	0.29	1.85	0.29	0.29
Toluene	8	0.55	4.78	2.01	7.70	2.01	2.01
n-Octane	4	0.02	0.17	0.09	0.42	0.05	0.04
Tetrachloroethylene	8	0.03	0.19	0.11	0.76	0.11	0.11
Ethylbenzene	8	0.08	1.08	0.39	1.72	0.39	0.39
m/p-Xylene/Bromoform	8	0.31	5.02	1.79	34.56	1.79	1.79
Styrene	5	0.03	0.17	0.09	0.39	0.06	0.06
o-Xylene/1,1,2,2-Tetrachloroethane	7	0.35	2.30	1.07	12.16	0.94	0.93
o-Dichlorobenzene	1	0.16	0.16	0.16	0.98	0.03	0.02

[a] A total of 8 samples were collected and analyzed by GC/MD.
[b] The arithmetic average concentration of all the compound identification cases.
[c] The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d] The arithmetic average concentration of all the sample cases using zero.

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Table 6-5

Air Toxics Compound Identifications Summary for B2AL - 1993

Compound	Cases[a]	Minimum (ppbv)	Maximum (ppbv)	Mean[b] (ppbv)	Mean[b] (μg/m³)	Mean[c] (ppbv)	Mean[d] (ppbv)
Propylene	8	0.08	1.39	0.60	1.06	0.60	0.60
1,3-Butadiene	2	0.06	0.08	0.07	0.16	0.06	0.02
Chloroform	8	0.03	0.11	0.06	0.27	0.06	0.06
1,1,1-Trichloroethane	8	0.26	0.38	0.32	1.80	0.32	0.32
Benzene	8	0.09	0.59	0.29	0.95	0.29	0.29
Carbon tetrachloride	8	0.20	0.35	0.29	1.84	0.29	0.29
Toluene	8	0.16	1.23	0.62	2.38	0.62	0.62
n-Octane	5	0.02	0.03	0.02	0.10	0.02	0.01
Tetrachloroethylene	8	0.01	0.06	0.04	0.28	0.04	0.04
Ethylbenzene	6	0.04	0.17	0.10	0.44	0.08	0.08
m/p-Xylene/Bromoform	8	0.14	0.67	0.39	7.61	0.39	0.39
Styrene	5	0.02	0.13	0.05	0.23	0.04	0.03
o-Xylene/1,1,2,2-Tetrachloroethane	6	0.11	0.42	0.26	3.00	0.20	0.20
o-Dichlorobenzene	1	0.27	0.27	0.27	1.65	0.04	0.03

[a] A total of 8 samples were collected and analyzed by GC/MD.
[b] The arithmetic average concentration of all the compound identification cases.
[c] The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d] The arithmetic average concentration of all the sample cases using zero.

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Table 6-6

Air Toxics Compound Identifications Summary for B3AL - 1993

Compound	Cases[a]	Minimum (ppbv)	Maximum (ppbv)	Mean[b] (ppbv)	Mean[b] (μg/m³)	Mean[c] (ppbv)	Mean[d] (ppbv)
Propylene	4	0.10	1.57	0.67	1.17	0.36	0.34
Chloromethane	2	0.53	0.72	0.63	1.31	0.23	0.16
Methylene chloride	2	0.52	2.85	1.69	5.95	0.46	0.42
Chloroform	8	0.02	0.10	0.05	0.24	0.05	0.05
1,1,1-Trichloroethane	8	0.26	0.74	0.47	2.59	0.47	0.47
Benzene	8	0.09	0.72	0.29	0.95	0.29	0.29
Carbon tetrachloride	8	0.22	0.46	0.31	1.99	0.31	0.31
Toluene	8	0.22	2.00	0.77	2.93	0.77	0.77
n-Octane	3	0.04	0.05	0.04	0.21	0.03	0.02
Tetrachloroethylene	8	0.02	1.82	0.38	2.59	0.38	0.38
Ethylbenzene	8	0.09	0.24	0.09	0.41	0.09	0.09
m/p-Xylene/Bromoform	8	0.09	1.00	0.40	7.64	0.40	0.40
Styrene	4	0.05	0.13	0.07	0.31	0.04	0.04
o-Xylene/1,1,2,2-Tetrachloroethane	7	0.06	0.52	0.20	2.28	0.18	0.18

[a]A total of 8 samples were collected and analyzed by GC/MD.
[b]The arithmetic average concentration of all the compound identification cases.
[c]The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d]The arithmetic average concentration of all the sample cases using zero.

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Table 6-7

Air Toxics Compound Identifications Summary for NWNJ - 1993

Compound	Cases[a]	Minimum (ppbv)	Maximum (ppbv)	Mean[b] (ppbv)	Mean[b] (µg/m³)	Mean[c] (ppbv)	Mean[d] (ppbv)
Propylene	8	1.05	11.03	3.47	6.06	3.47	3.47
1,3-Butadiene	4	0.03	0.30	0.14	0.30	0.09	0.07
Methylene chloride	1	3.00	3.00	3.00	10.59	0.42	0.38
Chloroform	8	0.02	0.20	0.08	0.38	0.08	0.08
1,1,1-Trichloroethane	8	1.23	4.24	2.17	12.04	2.17	2.17
Benzene	8	0.26	2.11	0.78	2.55	0.78	0.78
Carbon tetrachloride	8	0.24	0.39	0.33	2.09	0.33	0.33
Trichloroethylene	3	0.33	0.61	0.45	2.48	0.17	0.17
Toluene	8	1.12	10.04	3.58	13.71	3.58	3.58
n-Octane	8	0.03	0.57	0.18	0.84	0.18	0.18
Tetrachloroethylene	8	0.12	1.33	0.39	2.68	0.39	0.39
Chlorobenzene	1	0.05	0.05	0.05	0.23	0.02	0.01
Ethylbenzene	8	0.12	1.67	0.50	2.20	0.50	0.50
m/p-Xylene/Bromoform	8	0.62	8.41	2.45	47.42	2.45	2.45
Styrene	8	0.05	0.52	0.16	0.69	0.16	0.16
o-Xylene/1,1,2,2-Tetrachloroethane	8	0.31	3.92	1.15	13.07	1.15	1.15
p-Dichlorobenzene	2	0.16	0.16	0.16	0.98	0.07	0.04

[a] A total of 8 samples were collected and analyzed by GC/MD.
[b] The arithmetic average concentration of all the compound identification cases.
[c] The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d] The arithmetic average concentration of all the sample cases using zero.

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Table 6-8

Air Toxics Compound Identifications Summary for P1PA - 1993

Compound	Cases[a]	Minimum (ppbv)	Maximum (ppbv)	Mean[b] (ppbv)	Mean[b] (µg/m³)	Mean[c] (ppbv)	Mean[d] (ppbv)
Propylene	8	0.55	3.08	1.62	2.83	1.62	1.62
Chloromethane	1	0.79	0.79	0.79	1.66	0.19	0.10
1,3-Butadiene	3	0.07	0.11	0.09	0.21	0.07	0.04
Chloroform	8	0.03	0.26	0.11	0.53	0.11	0.11
1,1,1-Trichloroethane	8	0.30	4.00	1.70	9.41	1.70	1.70
Benzene	8	0.26	1.26	0.66	2.14	0.66	0.66
Carbon tetrachloride	8	0.21	0.38	0.29	1.85	0.29	0.29
Toluene	8	1.04	12.16	3.85	14.74	3.85	3.85
n-Octane	5	0.04	0.17	0.09	0.45	0.06	0.06
Tetrachloroethylene	8	0.11	0.48	0.27	1.83	0.27	0.27
Chlorobenzene	1	0.04	0.04	0.04	0.19	0.01	0.01
Ethylbenzene	6	0.12	0.61	0.31	1.35	0.23	0.23
m/p-Xylene/Bromoform	8	0.53	2.92	1.35	26.00	1.35	1.35
Styrene	4	0.04	0.42	0.19	0.82	0.10	0.10
o-Xylene/1,1,2,2-Tetrachloroethane	6	0.30	1.49	0.74	8.41	0.56	0.55
o-Dichlorobenzene	1	0.11	0.11	0.11	0.67	0.02	0.01

[a] A total of 8 samples were collected and analyzed by GC/MD.
[b] The arithmetic average concentration of all the compound identification cases.
[c] The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d] The arithmetic average concentration of all the sample cases using zero.

Table 6-9

Air Toxics Compound Identifications Summary for P2PA - 1993

Compound	Cases[a]	Minimum (ppbv)	Maximum (ppbv)	Mean[b] (ppbv)	Mean[b] (µg/m³)	Mean[c] (ppbv)	Mean[d] (ppbv)
Propylene	8	0.33	3.73	1.35	2.36	1.35	1.35
Chloromethane	1	0.42	0.42	0.42	0.88	0.14	0.05
1,3-Butadiene	4	0.03	0.08	0.06	0.13	0.06	0.03
Chloroform	8	0.04	0.10	0.07	0.35	0.07	0.07
1,1,1-Trichloroethane	8	0.45	1.50	0.84	4.63	0.84	0.84
Benzene	8	0.29	0.80	0.54	1.75	0.54	0.54
Carbon tetrachloride	8	0.24	0.38	0.31	2.00	0.31	0.31
Trichloroethylene	3	0.19	0.53	0.36	1.95	0.14	0.13
Toluene	8	0.65	4.40	1.83	7.00	1.83	1.83
n-Octane	7	0.02	0.07	0.04	0.21	0.04	0.04
Tetrachloroethylene	8	0.09	0.65	0.26	1.81	0.26	0.26
Chlorobenzene	2	0.02	0.04	0.03	0.14	0.02	0.01
Ethylbenzene	8	0.10	0.32	0.20	0.87	0.20	0.20
m/p-Xylene/Bromoform	8	0.44	1.50	0.92	17.86	0.92	0.92
Styrene	4	0.02	0.11	0.06	0.25	0.03	0.03
o-Xylene/1,1,2,2-Tetrachloroethane	8	0.30	0.78	0.54	6.14	0.54	0.54
m-Dichlorobenzene	1	0.52	0.52	0.52	3.18	0.07	0.07
p-Dichlorobenzene	5	0.10	0.43	0.22	1.36	0.16	0.14
o-Dichlorobenzene	2	0.10	0.19	0.15	0.89	0.04	0.04

[a] A total of 8 samples were collected and analyzed by GC/MD.
[b] The arithmetic average concentration of all the compound identification cases.
[c] The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d] The arithmetic average concentration of all the sample cases using zero.

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Table 6-10

Air Toxics Compound Identifications Summary for PLNJ - 1993

Compound	Cases[a]	Minimum (ppbv)	Maximum (ppbv)	Mean[b] (ppbv)	Mean[b] (µg/m³)	Mean[c] (ppbv)	Mean[d] (ppbv)
Propylene	7	0.46	7.52	3.27	5.73	2.87	2.86
Chloromethane	2	0.47	0.70	0.59	1.23	0.22	0.15
1,3-Butadiene	4	0.10	0.31	0.19	0.42	0.12	0.09
Methylene chloride	1	3.28	3.28	3.28	11.58	0.46	0.41
Chloroform	8	0.03	0.28	0.09	0.45	0.09	0.09
1,1,1-Trichloroethane	8	0.30	4.07	1.16	6.45	1.16	1.16
Benzene	8	0.18	3.09	1.04	3.37	1.04	1.04
Toluene	8	0.45	15.18	4.22	16.17	4.22	4.22
n-Octane	5	0.03	0.15	0.08	0.37	0.05	0.05
Tetrachloroethylene	8	0.11	0.74	0.26	1.77	0.26	0.26
Ethylbenzene	8	0.07	1.47	0.44	1.96	0.44	0.44
m/p-Xylene/Bromoform	8	0.28	7.08	2.14	41.33	2.14	2.14
Styrene	4	0.10	0.55	0.25	1.09	0.13	0.13
o-Xylene/1,1,2,2-Tetrachloroethane	8	0.16	3.16	1.14	12.99	1.14	1.14
p-Dichlorobenzene	1	0.28	0.28	0.28	1.71	0.07	0.04
o-Dichlorobenzene	1	0.06	0.06	0.06	0.37	0.02	0.01

[a]A total of 8 samples were collected and analyzed by GC/MD.
[b]The arithmetic average concentration of all the compound identification cases.
[c]The arithmetic average concentration of all the sample cases using half the MDL values for compounds not detected.
[d]The arithmetic average concentration of all the sample cases using zero.

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7.0 THREE-HOUR AIR TOXICS TECHNICAL NOTES

This section describes the equipment used to sample and analyze the 3-hour air toxics samples. Also described are sample handling procedures, sampler certification procedures, standard generation and instrument calibration procedures, compound identification procedures, GC/MS compound identification confirmation, QA/QC procedures, and data records for the 3-hour air toxics compounds.

7.1 Sampling Equipment and Gas Chromatograph/Multiple Detector Analytical System

The NMOC monitoring program sampling equipment, as described in Section 3.1, was identical to that used for the 3-hour air toxics sampling. The original sample was collected as an integrated ambient air sample from 6:00 a.m. to 9:00 a.m., local time, with a final sample pressure of approximately 15 psig. As stated above, after NMOC or speciated NMOC analysis, the canister was bled to atmospheric pressure and allowed to stand at least 18 hours before being analyzed by GC/MD.

The analytical system consisted of a Radian sample interface system and GC/MD. Figure 7-1 shows the GC/MD sampling system including the sample interface system, analytical system, and data system. When the 6-port valve was in the sample load mode, the sample interface served to cryogenically preconcentrate a measurable sample volume. In the sample inject mode, the cryogenically-focused water and organic compounds were thermally desorbed and swept by helium carrier gas to the head of the GC column. The GC oven was programmed so the sample was refocused on the column at subambient temperatures and then compounds were chromatographically separated. The toxic organic target compounds are listed in Table 7-1.

The Varian® 3400 gas chromatograph system consisted of a FID, PID, and ECD. The system used one column (J & W DB-1®, 60 M x 0.32 mm, and 1 μm film thickness) followed by a 1:10 splitter. The one-tenth portion of the splitter goes to the ECD. The nine-tenth portion of the splitter goes to the PID and then to the FID. Compound

Data System

Analytical System

Sample Interface System

Two 20MB Removable Cartridge Hard Drive Unit

IBM PC/AT Computer

Nelson Analytical A/D Interfaces

Varian® 3700 Gas Chromatograph

Sub Ambient Unit

Nitrogen Make up Gas

Flow Controller

Nitrogen Make up Gas

Flow Controller

Zero Grade Air

Hydrogen

Electron Capture Detector

Flame Ionization Detector

Photo Ionization Detector

Deactivated Fused Silica Transfer Line 0.50 mm ø 0.53 mm

Fixed Effluent Splitter

J & W Megabore® DB424 Capillary Column

= Thermocouple

A = Transfer Line to Analytical System
B = Transfer Line from Sample Container
C = Cryogenic Trap
D = Conduit Loop
E = Valve Oven
F = Room

Temperatures

On Column Injector

3-Way Valve

Helium Carrier Gas

Cryogenic Liquid Nitrogen Inlet

Vacuum Reservoir

Sample Valve (Load)

Sample Valve (Evacuate)

Reservoir Vacuum Gauge

Flow Controller

500 mL Control Vessel

Trap Assembly 1 (Cryogenic) 1/8" Stainless Steel

Trap Assembly 2 Conduit Loop

Valco High Temperature 8 port gas sampling valve enclosed in a temperature controlled oven with pneumatic actuator.

Isolation Valve

3-Way Routing Valve

Purge/Flood Valve

Vacuum Pump

Digital Temperature Readout

Temperature Rotary Selector

Valve Oven Temperature Controller

Transfer Line Temperature Controller

Trap Temperature Controller Omega Ramp & Soak

Heise Absolute Pressure/Vacuum Combination Gauge

Temperature Controlled 1/16" Stainless Steel Transfer Line

Sample Canister

Figure 7-1. Typical Gas Chromatograph/Multiple Detector System

12817798R

Table 7-1

Three-hour Air Toxics Target Compounds

Compound	CAS Number	AIRS Parameter Code
Acetylene	74-86-2	43206
Propylene	115-07-1	43205
Chloromethane	74-87-3	43801
Vinyl Chloride	75-01-4	43860
1,3-Butadiene	106-99-3	43218
Bromomethane	74-83-9	43819
Chloroethane	75-00-3	43812
Methylene Chloride	75-09-2	43802
trans-1,2-Dichloroethylene	156-60-5	43827
1,1-Dichloroethane	75-34-3	43813
Chloroprene	126-99-8	43835
Bromochloromethane	74-97-5	43836
Chloroform	67-66-3	43803
1,2-Dichloroethane	107-06-2	43815
1,1,1-Trichloroethane	71-88-6	43814
Benzene	71-43-2	45201
Carbon tetrachloride	56-23-5	43804
1,2-Dichloropropane	78-87-5	43829
Bromodichloromethane	75-27-4	43828
Trichloroethylene	79-01-6	43524
cis-1,3-Dichloropropylene	10061-01-5	43831
trans-1,3-Dichloropropylene	10061-02-6	43830
1,1,2-Trichloroethane	79-00-5	43820
Toluene	108-88-3	45202
Dibromochloromethane	124-48-1	43832

Table 7-1, Continued

Compound	CAS Number	AIRS Parameter Code
n-Octane	111-65-9	43233
Tetrachloroethylene	127-18-4	43817
Chlorobenzene	108-90-7	45801
Ethylbenzene	100-41-4	45203
m/p-Xylene/Bromoform	NA	45111
Styrene	100-42-5	45220
o-Xylene/1,1,2,2-Tetrachloroethane	NA	45112
m-Dichlorobenzene	541-73-1	45806
p-Dichlorobenzene	106-46-7	45807
o-Dichlorobenzene	95-50-1	45805

identification was made using a combination of retention time, ratios of PID/FID and/or ECD/FID responses, and analyst experience and judgment. Quantitation was performed using the FID response, with the exception of halogenated compounds that were quantitated using the ECD. Propylene was quantitated from the PID as the FID had an interference peak (propane) with this compound. The sample concentrations were calculated by using the monthly calibration curve and daily standard response factors times the sample area counts of each target compound.

7.2   Three-Hour Air Toxics Sampling Systems Certification

The sampling systems used to collect 3-hour air toxics samples were certified for use per the specifications described in the EPA Compendium of Methods TO-14.[12]

7.2.1 Sampler Certification Blanks--Humidified Zero Air

Zero certification consisted of purging the sampler with cleaned, humidified air, followed by collecting a sample of the cleaned, dried air that had been humidified through the purged NMOC samplers for GC/MD analysis. The purpose of the wet purge was to help remove any adherent contaminant from the sampler. The chromatograms from these certification sample analyses were archived for each sampler. Results showed a range of 0.0 ppbv to 0.32 ppbv (for benzene), with an average of 0.04 ppbv. The sampling systems were determined to be clean and showed no characteristics of additive bias.

7.2.2 Sampler Certification Challenge - Selected Target Compound

Following the NMOC sampler blank certification, a challenge gas containing five selected target compounds was passed through the samplers. The average concentration of the compounds in the challenge gas was 15.98 ppbv/species. Average percent recoveries ranged from 91.12% to 107.74% with an overall average of 100.20 percent.

7.3 Calibration Standard Preparation

Calibration curves for the multi-detector included a 5-point calibration initially, and daily calibration checks at an average 5 ppbv concentration for the target compounds. The origin of the calibration curve was used as one of the calibration points.

7.3.1 Calibration Standard Generation

A monthly calibration of the target compounds was performed by analyzing humidified standards prepared at levels of approximately 0.5, 1, 3, 5, and 10 ppbv from Scott® Specialty Gases certified standards. A standard prepared at a level of approximately 5 ppbv from a Scott® Specialty Gases certified standard was used for daily calibration. These standards were prepared using the dynamic flow dilution system. The gases were mixed in a SUMMA®-treated mixing sphere and bled into evacuated canisters. One dilution air stream was routed through a SUMMA®-treated bubbler containing HPLC-grade water to humidify, and the other stream was not humidified. The dilution air streams were brought together to mix with the streams for the certified cylinders. Flow rates from all five streams (four from the certified cylinders and one from the dilution cylinder) were gauged and controlled by mass flow controllers. The split air dilution streams were metered by "wet" and "dry" rotameters from the humidified and unhumidified dilutions air streams, respectively. The system was evacuated with a vacuum pump while the closed canister was connected. A precision absolute pressure gauge measured the canister pressure before and after filling. The lines leading to the canister and to the mixing sphere were flushed for at least 15 minutes with standard gas before being connected to the canister for filling.

7.3.2 GC/MD Calibration

Initial and monthly calibration curve standards were made at 0.5, 1, 3, 5, and 10 ppbv for each of the target compounds. In addition, the point at 0.0 was considered to be a calibration point. A linear regression was performed for each of the compounds with the objective for the correlation coefficient being 0.990 or better (for 5 or 6 points) for selected compounds on the detector used for quantitation. The zero air used for canister cleaning and for standards dilution was analyzed at the time of calibration, but the results were not used in the calibration curve. Daily calibration was done with in-house standards made from the certified gases with an average concentration of 5 ppbv.

The calibration standard concentrations and area counts for each compound were entered into a spreadsheet. The result response factors of each compound were compared to the monthly calibration curve's response factors. An absolute value of the less than or equal to 30% was the guideline for the quantitated compounds.

All daily calibration data were used to calculate calibration factors for each compound on each detector. Minima, means, maxima, and standard deviations were recorded and tabulated for each detector. The FID calibration factors were used for quantitation for most of the compounds except some halocarbons. The ECD calibration factors were used in most cases of halogenated compound quantitation because of the greater sensitivity of the ECD at low concentrations. The PID calibration factor was used for propylene.

7.3.3 GC/MD Calibration Results

Two calibration curves were used during the analysis period. In the first calibration curve, 7 of the 38 compound linear regression coefficients were less than 0.990. They ranged from 0.973 to 0.988. The 30% objective was exceeded by 4 of the 38 compounds. They ranged from 30.23 to 37.52 percent.

In the second calibration curve, 8 of the 38 compound linear regression coefficients were less than 0.990. They ranged from 0.940 to 0.988. The 30% objective was exceeded by 9 of the 38 compounds. They ranged from 30.98 to 66.27 percent.

7.4   Daily Calibration Check

Prior to sample analysis, a 5 ppbv standard was analyzed to ensure the validity of the current monthly response factor. This daily check was at the middle range of the calibration curve to show consistency with the monthly calibration curve. The daily standard concentrations and area counts for each compound were entered into a spreadsheet. The resulting response factors of each compound were compared to the monthly calibration curve's response factors. An absolute value of less than or equal to 30% was the guideline for the quantitated compounds. After acceptance of the daily standard, a wet zero was analyzed. Resulting concentrations for target amounts of less than 0.2 ppbv was the objective except for known detector interferences. If more than a 0.2 ppbv concentration was found, a second wet zero was run. If a second wet zero failed, system maintenance was performed.

7.5   Gas Chromatograph/Mass Spectrometer Analysis and Compound Identification Confirmation

Seven of the 3-hour air toxics samples were analyzed by GC/MS for compound identification confirmation following completion of the GC/MD analyses. The GC/MS was operated in a full scan mode.

No comparison of the quantitative results for GC/MD and GC/MS was made because the purpose of the GC/MS analyses was compound identification confirmation only. This comparison is discussed in Section 7.6.1.

7.6   QA/QC Data

Precision was estimated from duplicate samples and repeated analysis. Table 7-2 summarizes the duplicate and replicate analyses performed on the five 3-hour air toxics samples. Columns headed D1, R, and D2 were taken from the tables in Appendix H. Columns D1 and D2 show the results of the samples in duplicate Canisters 1 and 2, respectively. Column R shows the results of the second analysis of duplicate Canister D1. The analytical precision was estimated from the replicate analyses, Columns R and D1. The sampling and analytical precisions was estimated from the duplicate canister analyses.

In the columns under "Replicate Analyses", the following applies:

- Replicate Average represents the average concentrations (in analyses Columns D1 and R);

- Standard Deviation represents the standard deviation (between analyses Columns D1 and R);

- %CV (standard deviation/average * 100); and

- Abs %Diff represents the absolute percent difference.

The %CV for replicates ranged from 0.00 to 60.6%, and absolute percent difference ranged from 0.00 to 85.71 percent. The pooled %CV was 22.01, while the average absolute percent difference was 20.80. These are excellent results, considering the small number of samples involved, and compare favorably with previous 3-hour air toxics replicate analysis results.

Duplicate sample statistics are shown in the last four columns of Table 7-2. Duplicate average represents the best estimate of the sample mean. It was calculated first by averaging Columns D1 and R analyses in the first duplicate canister and then averaging the first average with Column D2. The duplicate standard deviation was calculated using the average of Columns D1 and R and comparing it with Column D2.

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Table 7-2

1993 NMOC Three-Hour Replicate and Duplicates, ppbv

Compound	D1	R	D2	Replicate Analyses				Duplicate Analyses			
				Replicate Average	Standard Deviation	%CV	Absolute % Diff	Duplicate Average	Standard Deviation	%CV	Absolute % Diff
B1AL											
Propylene	1.00	0.83	0.76	0.915	0.120	13.138	18.579	0.838	0.110	13.087	18.507
1,3-Butadiene	0.05	0.02	0.06	0.035	0.021	60.609	85.714	0.048	0.018	37.216	52.632
Chloroform	0.03	0.03	0.05	0.030	0.000	0.000	0.000	0.040	0.014	35.355	50.000
1,1,1-Trichloroethane	0.29	0.32	0.30	0.305	0.021	6.955	9.836	0.303	0.004	1.169	1.653
Benzene	0.54	0.65	0.64	0.595	0.078	13.073	18.487	0.618	0.032	5.153	7.287
Carbon tetrachloride	0.22	0.24	0.22	0.230	0.014	6.149	8.696	0.225	0.007	3.143	4.444
Toluene	1.16	1.13	1.33	1.145	0.021	1.853	2.620	1.238	0.131	10.571	14.949
n-Octane	0.15	0.10	0.12	0.125	0.035	28.284	40.000	0.123	0.004	2.886	4.082
Tetrachloroethylene	0.07	0.08	0.08	0.075	0.007	9.428	13.333	0.078	0.004	4.562	6.452
Ethylbenzene	0.20	0.19	0.24	0.195	0.007	3.626	5.128	0.218	0.032	14.630	20.690
m/p-Xylene/Bromoform	0.93	0.88	1.18	0.905	0.035	3.907	5.525	1.043	0.194	18.653	26.379
Styrene	0.06	0.06	0.08	0.060	0.000	0.000	0.000	0.070	0.014	20.203	28.571
o-Xylene/1,1,2,2-Tetrachloroethane	0.47	0.49	0.57	0.480	0.014	2.946	4.167	0.525	0.064	12.122	17.143
B2AL											
Propylene	1.50	1.19	1.47	1.345	0.219	16.298	23.048	1.408	0.088	6.280	8.881
1,3-Butadiene	0.09	0.05	0.09	0.070	0.028	40.406	57.143	0.080	0.014	17.678	25.000
Chloroform	0.04	0.07	0.23	0.055	0.021	38.569	54.545	0.143	0.124	86.838	122.807

Table 7-2

Continued

Compound	D1	R	D2	Replicate Analyses				Duplicate Analyses			
				Replicate Average	Standard Deviation	%CV	Absolute % Diff	Duplicate Average	Standard Deviation	%CV	Absolute % Diff
1,1,1-Trichloroethane	0.29	0.34	0.29	0.315	0.035	11.224	15.873	0.303	0.018	5.844	8.264
Benzene	0.44	0.61	0.41	0.525	0.120	22.897	32.381	0.468	0.081	17.394	24.599
Carbon tetrachloride	0.22	0.23	0.21	0.225	0.007	3.143	4.444	0.218	0.011	4.877	6.897
Toluene	1.03	1.25	1.09	1.140	0.156	13.646	19.298	1.115	0.035	3.171	4.484
n-Octane	0.03		0.02								
Tetrachloroethylene	0.04	0.05	0.08	0.045	0.007	15.713	22.222	0.063	0.025	39.598	56.000
Ethylbenzene	0.15	0.17	0.15	0.160	0.014	8.839	12.500	0.155	0.007	4.562	6.452
m/p-Xylene/Bromoform	0.62	0.72	0.63	0.670	0.071	10.554	14.925	0.650	0.028	4.351	6.154
Styrene	0.11	0.17	0.10	0.140	0.042	30.305	42.857	0.120	0.028	23.570	33.333
o-Xylene/1,1,2,2-Tetrachloroethane	0.36	0.55	0.36	0.455	0.134	29.528	41.758	0.408	0.067	16.485	23.313
B3AL											
Propylene	1.40	1.46	1.84	1.430	0.042	2.967	4.196	1.635	0.290	17.732	25.076
Methylene Chloride	2.61		3.09								
Chloroform	0.06	0.09	0.06	0.075	0.021	28.284	40.000	0.068	0.011	15.713	22.222
1,1,1-Trichloroethane	0.70	0.83	0.69	0.765	0.092	12.016	16.993	0.728	0.053	7.290	10.309
Benzene	0.61	0.93	0.61	0.770	0.226	29.386	41.558	0.690	0.113	16.397	23.188
Carbon tetrachloride	0.24	0.29	0.24	0.265	0.035	13.342	18.868	0.253	0.018	7.001	9.901
Toluene	1.81	2.45	1.73	2.130	0.453	21.246	30.047	1.930	0.283	14.655	20.725

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Table 7-2

Continued

Compound	D1	R	D2	Replicate Analysis				Duplicate Analyses			
				Replicate Average	Standard Deviation	%CV	Absolute % Diff	Duplicate Average	Standard Deviation	%CV	Absolute % Diff
n-Octane	0.03		0.04								
Tetrachloroethylene	1.87	1.74	1.84	1.805	0.092	5.093	7.202	1.823	0.025	1.358	1.920
Ethylbenzene	0.23	0.26	0.22	0.245	0.021	8.658	12.245	0.233	0.018	7.603	10.753
m/p-Xylene/Bromoform	0.93	1.15	0.92	1.040	0.156	14.958	21.154	0.980	0.085	8.658	12.245
Styrene	0.11	0.14	0.14	0.125	0.021	16.971	24.000	0.133	0.011	8.005	11.321
o-Xylene/1,1,2,2-Tetrachloroethane	0.45	0.61	0.49	0.530	0.113	21.347	30.189	0.510	0.028	5.546	7.843
NWNJ											
Propylene	1.11	1.09	0.96	1.100	0.014	1.286	1.818	1.030	0.099	9.611	13.592
Chloroform	0.04		0.03								
1,1,1-Trichloroethane	4.59	3.93	3.96	4.260	0.467	10.955	15.493	4.110	0.212	5.161	7.299
Benzene	0.30	0.25	0.22	0.275	0.035	12.856	18.182	0.248	0.039	15.713	22.222
Carbon tetrachloride	0.31	0.24	0.25	0.275	0.049	17.999	25.455	0.263	0.018	6.734	9.524
Toluene	1.99	1.73	1.58	1.860	0.184	9.884	13.978	1.720	0.198	11.511	16.279
n-Octane	0.05	0.04		0.045	0.007	15.713	22.222				
Tetrachloroethylene	0.35	0.29	0.28	0.320	0.042	13.258	18.750	0.300	0.028	9.428	13.333
Ethylbenzene	0.27	0.21	0.21	0.240	0.042	17.678	25.000	0.225	0.021	9.428	13.333
m/p-Xylene/Bromoform	1.23	1.02	1.05	1.125	0.148	13.199	18.667	1.088	0.053	4.877	6.897
Styrene	0.18	0.11	0.12	0.145	0.049	34.136	48.276	0.133	0.018	13.342	18.868

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Table 7-2

Continued

Compound	D1	R	D2	Replicate Analyses				Duplicate Analyses			
				Replicate Average	Standard Deviation	%CV	Absolute % Diff	Duplicate Average	Standard Deviation	%CV	Absolute % Diff
o-Xylene/1,1,2,2-Tetrachloroethane	0.64	0.41	0.40	0.525	0.163	30.978	43.810	0.463	0.088	19.111	27.027
p-Dichlorobenzene	0.16										
P1PA											
Propylene	0.61	0.57	0.59	0.590	0.028	4.794	6.780	0.590	0.000	0.000	0.000
Chloroform	0.02	0.02	0.04	0.020	0.000	0.000	0.000	0.030	0.014	47.140	66.667
1,1,1-Trichloroethane	0.26	0.30	0.35	0.280	0.028	10.102	14.286	0.315	0.049	15.713	22.222
Benzene	0.26	0.26	0.26	0.260	0.000	0.000	0.000	0.260	0.000	0.000	0.000
Carbon tetrachloride	0.20	0.22	0.22	0.210	0.014	6.734	9.524	0.215	0.007	3.289	4.651
Toluene	0.70	0.77	2.28	0.735	0.049	6.734	9.524	1.508	1.092	72.470	102.488
n-Octane		0.03									
Tetrachloroethylene	0.20	0.28	0.26	0.240	0.057	23.570	33.333	0.250	0.014	5.657	8.000
Ethylbenzene	0.09	0.10	0.16	0.095	0.007	7.443	10.526	0.128	0.046	36.049	50.980
m/p-Xylene/Bromoform	0.45	0.51	0.67	0.480	0.042	8.839	12.500	0.575	0.134	23.365	33.043
Styrene			0.04								
o-Xylene/1,1,2,2-Tetrachloroethane	0.31	0.33	0.32	0.320	0.014	4.419	6.250	0.320	0.000	0.000	0.000
P2PA											
Propylene	1.75	1.45	1.41	1.600	0.212	13.258	18.750	1.505	0.134	8.927	12.625
1,3-Butadiene	0.07	0.08	0.08	0.075	0.007	9.428	13.333	0.078	0.004	4.562	6.452

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Table 7-2

Continued

Compound	D1	R	D2	Replicate Analyses				Duplicate Analyses			
				Replicate Average	Standard Deviation	%CV	Absolute % Diff	Duplicate Average	Standard Deviation	%CV	Absolute % Diff
Chloroform	0.05	0.04	0.07	0.045	0.007	15.713	22.222	0.058	0.018	30.744	43.478
1,1,1-Trichloroethane	0.69	0.63	0.67	0.660	0.042	6.428	9.091	0.665	0.007	1.063	1.504
Benzene	0.79	0.85	0.77	0.820	0.042	5.174	7.317	0.795	0.035	4.447	6.289
Carbon tetrachloride	0.25	0.24	0.24	0.245	0.007	2.886	4.082	0.243	0.004	1.458	2.062
Toluene	2.38	2.30	2.32	2.340	0.057	2.417	3.419	2.330	0.014	0.607	0.858
n-Octane	0.09		0.05								
Tetrachloroethylene	0.73	0.50	0.72	0.615	0.163	26.445	37.398	0.668	0.074	11.123	15.730
Chlorobenzene	0.02										
Ethylbenzene	0.29	0.33	0.28	0.310	0.028	9.124	12.903	0.295	0.021	7.191	10.169
m/p-Xylene/Bromoform	1.46	1.44	1.40	1.450	0.014	0.975	1.379	1.425	0.035	2.481	3.509
Styrene	0.10		0.12								
o-Xylene/1,1,2,2-Tetrachloroethane	0.75	0.58	0.72	0.665	0.120	18.076	25.564	0.693	0.039	5.616	7.942
PLNJ											
Propylene	3.29	3.12	3.62	3.205	0.120	3.751	5.304	3.413	0.293	8.599	12.161
1,3-Butadiene	0.11	0.09	0.15	0.100	0.014	14.142	20.000	0.125	0.035	28.284	40.000
Chloroform	0.05	0.02	0.05	0.035	0.021	60.609	85.714	0.043	0.011	24.957	35.294
1,1,1-Trichloroethane	0.60	0.48	0.52	0.540	0.085	15.713	22.222	0.530	0.014	2.668	3.774
Benzene	1.20	1.06	1.02	1.130	0.099	8.761	12.389	1.075	0.078	7.236	10.233

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Table 7-2

Continued

Compound	D1	R	D2	Replicate Analyses				Duplicate Analyses			
				Replicate Average	Standard Deviation	%CV	Absolute % Diff	Duplicate Average	Standard Deviation	%CV	Absolute % Diff
Carbon tetrachloride	0.26	0.23	0.22	0.245	0.021	8.658	12.245	0.233	0.018	7.603	10.753
Toluene	4.69	3.80	4.03	4.245	0.629	14.825	20.966	4.138	0.152	3.674	5.196
n-Octane	0.09		0.10								
Tetrachloroethylene	0.15	0.11	0.14	0.130	0.028	21.757	30.769	0.135	0.007	5.238	7.407
Ethylbenzene	0.49	0.34	0.38	0.415	0.106	25.558	36.145	0.398	0.025	6.226	8.805
m/p-Xylene/Bromoform	2.32	1.61	1.83	1.965	0.502	25.549	36.132	1.898	0.095	5.031	7.115
Styrene	0.22	0.28	0.17	0.250	0.042	16.971	24.000	0.210	0.057	26.937	38.095
o-Xylene/1,1,2,2-Tetrachloroethane	1.20	1.98	0.88	1.590	0.552	34.688	49.057	1.235	0.502	40.651	57.490
			Average	0.694			20.804	0.702			19.213
			Median	0.315				0.309			
			Cases	80				79			
		Pooled Standard Deviation			0.153				0.161		
		Pooled % CV				22.014				22.888	

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The %CV for duplicates was calculated as the quotient of the standard deviation and the average, multiplied by 100. Finally, the absolute percent difference was calculated from the difference between the average concentrations of the duplicate canisters, divided by the average concentration in the duplicate canisters, expressed as a percentage. The %CV ranged from 0.00 to 86.84. The pooled %CV was 22.89. Absolute percent difference ranged from 0.00 to 122.81. The average absolute percent difference for duplicates was 19.21, which is an excellent result.

7.6.1 GC/MS Confirmation Results

Based on seven GC/MS analyses of the 3-hour air toxics samples, one from each site location, the following results were obtained. The GC/MS analyses confirmed 93.19% of the GC/MD analyses. The results are summarized in Table 7-3, showing 13.61% positive GC/MD-positive GC/MS confirmation, 3.67% positive GC/MD-negative GC/MS comparisons 3.14% negative GC/MD-positive GC/MS comparisons, and 79.58% negative GC/MD-negative GC/MS confirmation.

7.6.2 External Audits

The external audit for the 3-hour air toxics compounds was conducted with the SNMOC external audit. Table 7-4 presents the results from the external audit. The external audit sample was provided by an EPA contractor.

7.7 Sample Dilutions

Upon review of the sample analysis results, when a compound concentration was outside the calibration range, the sample was diluted and reanalyzed for the compound or compounds out of range. The dilutions were performed in accordance with the Radian SOP, "Standard Operating Procedure for Dilution of Canister Samples Using the Vacuum Assessment Dilution System."

Table 7-3

Compound Identification Confirmation

GC/MD versus GC/MS Comparison[a]	Cases	Percentage
Positive GC/MD - Positive GC/MS	26	13.61
Positive GC/MD - Negative GC/MS	7	3.67
Negative GC/MD - Positive GC/MS	6	3.14
Negative GC/MD - Negative GC/MS	152	79.58
Total	191	100.00

Total compound identification confirmation = 13.61% + 79.58% = 93.19%

[a]There were 47 cases where the GC/MD identified a compound at a concentration below the detection limit of the GC/MS.

Table 7-4

Three-hour Toxics External Audit Results

Compound	Spiked	Reported	% Difference
Benzene	0.0	0.02	NA[a]
Toluene	0.0	0.03	NA
Ethylbenzene	9.3	3.8	-59.1
m/p-Xylene/Bromoform	9.3	9.1	-2.2
o-Xylene/1,1,2,2-Tetrachlorethane	9.0	13.2	46.7

[a]NA = Not Applicable.

The procedure required that the canister be connected to the vacuum assessment system. The initial canister vacuum was recorded and the canister was then filled with nitrogen to a known final pressure. The room temperature and barometric pressure at the time of dilution were also recorded. The initial vacuum, final pressure, room temperature, and barometric pressure were used to calculate the dilution factor. The sample was allowed to equilibrate for at least 18 hours. The sample was then bled to atmospheric pressure, allowed to equilibrate for an additional 18 hours and reanalyzed. Analysis was only for the compound or compounds initially out of the calibration range.

For the 1993 NMOC program, four samples were diluted by the procedure outlined above. Sample 1209 (P1PA) was diluted for toluene and Sample 1751 (PLNJ) was diluted for toluene and propylene. Because of low initial sample pressures, Samples 1754 (NWNJ) and 1752 (P1PA) were also diluted in order to achieve a required minimum sample pressure for GC/MS analysis. Because the GC/MS analysis was performed prior to the GC/MD analysis for these two samples, the dilution factor was applied to both GC/MS and GC/MD analysis results.

7.8   Data Records

Data records for the 3-hour air toxics samples included:

- NMOC concentration of the sample;

- Copies of the gas chromatographic trace for FID, PID, and ECD;

- Response data on removable hard disk;

- Retention times for each compound; and

- Area counts for each detector.

In addition, daily calibration response factors were recorded on magnetic disk along with the retention time and area counts for each compound in the standard.

8.0 CARBONYL COMPOUNDS SAMPLING, ANALYSIS, AND QUALITY ASSURANCE PROCEDURES

Carbonyl sampling and analysis procedures and QA procedures used to assess data quality are described in this section.

8.1 Data Summary

Analytical results of ambient air samples and trip blanks for carbonyl compounds at Plainfield, New Jersey (PLNJ) and Newark, New Jersey (NWNJ) are given in Tables 8-1 and 8-2, respectively. The concentrations of targeted carbonyl compounds in the trip blanks were calculated assuming the sample volume calculated for the accompanying samples. In cases where duplicate samples were taken, or replicate analyses were performed, the results of all the analyses were averaged for each sample. The mean refers to the daily sample averages, not the averages of all the analyses. The concentrations given for the samples were not blank corrected. Table 8-3 gives the average, maximum, and minimum carbonyl concentration as well as the standard deviation and frequency of occurrence for each of the targeted carbonyl compounds for PLNJ. Table 8-4 gives the same statistical values listed above for NWNJ. For PLNJ, the average of those compounds identified ranged from 0.063 ppbv for acetaldehyde to 42.02 ppbv for formaldehyde. For NWNJ, the average of those compounds identified ranged from 0.75 ppbv for acetaldehyde to 14.54 ppbv for acetone.

8.2 Sampling Equipment and Procedures

A schematic diagram of the 3-hour carbonyl sampling sub-system is shown in Figure 8-1. The 3-hour carbonyl sampling subsystem collects a discrete sample concurrent with the collection of the NMOC canister sample through the use of a common control system.

Table 8-1

1993 NMOC Plainfield, New Jersey Carbonyl Results

NMOC Sample ID	1222-A	1222-A DUP	1222-B	1222-B DUP	1222-BLK	1222-BLK DUP	1630-B	1658-B
Sample Volume (L)	217?	217?	122.00	122.00	122.00	122.00a	122.00a	121.91
Data File ID	RC327/84	RC327/85	RC327/86	RC327/87	RC327/88	RC327/89	RC327/811	RC327/814
Date Sampled	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/13/93	08/17/93
Date Extracted	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
Date Analyzed	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Concentration (ppbv)								
Formaldehyde	7.46	8.24	8.98	9.26	7.52	7.67	4.69	12.22
Acetaldehyde	5.19	6.09	4.54	4.35	1.24	1.38	2.78	4.32
Acrolein	ND[b]	ND	ND	ND	ND	ND	ND	ND
Acetone	14.46	15.30	13.93	13.33	3.11	3.32	4.41	8.08
Propionaldehyde	ND	ND	0.47	0.34[c]	ND	ND	ND	0.07[c]
Crotonaldehyde	ND	ND	0.34	0.44	ND	ND	ND	ND
Butyr/Isobutyraldehyde	ND	ND	0.94	ND	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Isovaleraldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Valeraldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Tolualdehydes	ND	ND	ND	ND	ND	ND	ND	ND
Hexanaldehyde	ND	ND	0.42	0.48	ND	ND	ND	ND
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND	ND	ND	ND

[a] Sample volume is assumed to be the same as the accompanying samples for blank samples.
[b] ND = Not Detected.
[c] Estimated concentration is less than the detection limit for the given sample volume.

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Table 8-1

Continued

NMOC Sample ID	1761-B	1838-B	1852-B	1958-B	1957-B	2031-B	2037-B
Sample Volume (L)	113.29	117.65	117.65	111.11	118.74	123.09	123.09
Data File ID	RC327810	RC327822	RC327825	RC327833	RC327830	RC327836	RC327839
Date Sampled	05/26/93	09/03/93	09/08/93	09/17/93	09/20/93	09/28/93	09/29/93
Date Extracted	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
Date Analyzed	10/06/93	10/06/93	10/06/93	10/06/93	10/06/93	10/06/93	10/06/93
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Concentration (ppbv)							
Formaldehyde	42.02	5.58	4.43	3.51	2.89	3.64	2.77
Acetaldehyde	5.35	6.60	1.24	0.63[c]	1.16	1.21	0.96
Acrolein	0.92	ND	ND	ND	ND	ND	ND
Acetone	10.64	7.64	3.09	2.06	4.17	2.96	3.69
Propionaldehyde	0.20[c]	ND	ND	ND	ND	ND	ND
Crotonaldehyde	ND	ND	ND	ND	ND	ND	ND
Butyr/Isobutyraldehyde	1.08	0.40	ND	ND	ND	ND	ND
Benzaldehyde	0.07[c]	ND	ND	ND	ND	ND	ND
Isovaleraldehyde	ND	ND	ND	ND	ND	ND	ND
Valeraldehyde	0.75	ND	ND	ND	ND	ND	ND
Tolualdehydes	ND	ND	ND	ND	ND	ND	ND
Hexanaldehyde	2.62	0.10[c]	ND	ND	ND	ND	ND
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND	ND	ND

[a] Sample volume is assumed to be the same as the accompanying samples for blank samples.
[b] ND = Not Detected.
[c] Estimated concentration is less than the detection limit for the given sample volume.

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Table 8-2

1993 NMOC Newark, New Jersey Carbonyl Results

NMOC Sample ID	1533-A	1533-A DUP	1533-B	1533-B DUP	1533-BLK	1533-BLK DUP	1614-B	1646-B
Sample Volume (L)	141.A5	141.A5	145.55	145.55	145.55[a]	145.55[a]	139.40	143.50
Data File ID	RC32794	RC32795	RC32796	RC32797	RC32798	RC32799	RC32911	RC32914
Date Sampled	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/13/93	08/17/93
Date Extracted	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
Date Analyzed	10/06/93	10/06/93	10/06/93	10/06/93	10/06/93	10/06/93	10/06/93	10/07/93
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Concentration (ppbv)								
Formaldehyde	9.36	9.24	9.13	9.72	ND	ND	4.09	4.14
Acetaldehyde	4.05	4.25	3.99	4.08	ND	ND	2.35	2.11
Acrolein	ND[b]	ND	ND	ND	ND	ND	ND	ND
Acetone	13.34	13.96	13.04	13.80	0.48	0.49	3.69	4.28
Propionaldehyde	0.46	0.44	0.39	0.35[c]	ND	ND	ND	ND
Crotonaldehyde	0.29	0.22[c]	0.15[c]	0.43	ND	ND	ND	ND
Butyr/Isobutyraldehyde	1.33	1.15	0.45	1.36	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Isovaleraldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Valeraldehyde	0.43	0.48	0.42	0.56	ND	ND	ND	ND
Tolualdehydes	ND	ND	ND	ND	ND	ND	ND	ND
Hexanaldehyde	0.96	0.85	1.06	1.15	ND	ND	ND	ND
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND	ND	ND	ND

[a] Sample volume is assumed to be the same as the accompanying samples for blank samples.
[b] ND = Not Detected.
[c] Estimated concentration is less than the detection limit for the given sample volume.

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Table 8-2

Continued

NMOC Sample ID	1765-B	1790-B	1819-A	1839-B	1941-B	1971-B	2030-B
Sample Volume (L)	143.50	143.50	141.45	139.40	139.40	143.50	139.40
Data File ID	RC327919	RC327922	RC327924	RC327920	RC327933	RC327936	RC327939
Date Sampled	08/26/93	08/30/93	09/03/93	09/08/93	09/16/93	09/20/93	09/28/93
Date Extracted	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/15/93
Date Analyzed	10/07/93	10/07/93	10/07/93	10/07/93	10/07/93	10/07/93	10/07/93
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Concentration (ppbv)							
Formaldehyde	5.94	7.87	2.61	3.41	2.14	3.76	2.86
Acetaldehyde	2.82	3.76	2.57	1.53	0.75	2.01	1.14
Acrolein	ND	ND	ND	ND	ND	ND	ND
Acetone	14.54	8.18	2.44	3.16	2.48	9.28	3.19
Propionaldehyde	ND	0.31[c]	ND	ND	ND	ND	ND
Crotonaldehyde	0.13[c]	0.13[c]	ND	0.08[c]	ND	ND	ND
Butyr/Isobutyraldehyde	ND	0.04[c]	ND	ND	ND	0.40	ND
Benzaldehyde	ND	ND	ND	ND	ND	ND	ND
Isovaleraldehyde	ND	ND	ND	ND	ND	ND	ND
Valeraldehyde	ND	ND	ND	ND	ND	ND	ND
Tolualdehydes	ND	ND	ND	ND	ND	ND	ND
Hexanaldehyde	0.38	0.52	ND	ND	ND	ND	ND
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND	ND	ND

[a]Sample volume is assumed to be the same as the accompanying samples for blank samples.
[b]ND = Not Detected.
[c]Estimated concentration is less than the detection limit for the given sample volume.

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Table 8-3

1993 NMOC Plainfield, New Jersey Site Summary

Analyte	Average Conc (ppbv)	Maximum Conc (ppbv)	Minimum Conc (ppbv)	Standard Deviation	Frequency (%)
Formaldehyde	9.02	42.02	2.77	11.35	100
Acetaldehyde	2.93	6.60	0.63	2.09	100
Acrolein	0.09	0.92	0.00	0.28	10
Acetone	6.10	14.26	2.06	3.76	100
Propionaldehyde	0.05	0.20	ND[a]	0.08	30
Crotonaldehyde	0.02	0.20	ND	0.06	10
Butyr/Isobutyraldehyde	0.17	1.08	ND	0.33	30
Benzaldehyde	0.01	0.07	ND	0.02	10
Isovaleraldehyde	ND	ND	ND	ND	ND
Valeraldehyde	0.08	0.75	ND	0.23	10
Tolualdehydes	ND	ND	ND	ND	ND
Hexanaldehyde	0.29	2.62	ND	0.78	30
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND

[a] = Not Detected.

Table 8-4

1993 NMOC Newark, New Jersey Site Summary

Analyte	Average Conc (ppbv)	Maximum Conc (ppbv)	Minimum Conc (ppbv)	Standard Deviation	Frequency (%)
Formaldehyde	4.62	9.36	2.14	2.25	100
Acetaldehyde	2.31	4.09	0.75	1.01	100
Acrolein	ND	ND	ND	ND	ND
Acetone	6.48	14.54	2.44	4.38	100
Propionaldehyde	0.07	0.41	ND	0.15	20
Crotonaldehyde	0.10	0.68	ND	0.20	40
Butyr/Isobutyraldehyde	0.15	1.07	ND	0.33	30
Benzaldehyde	ND	ND	ND	ND	ND
Isovaleraldehyde	ND	ND	ND	ND	ND
Valeraldehyde	0.04	0.41	ND	0.12	10
Tolualdehydes	ND	ND	ND	ND	ND
Hexanaldehyde	0.19	1.01	ND	0.33	30
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND

[a]ND = Not Detected.
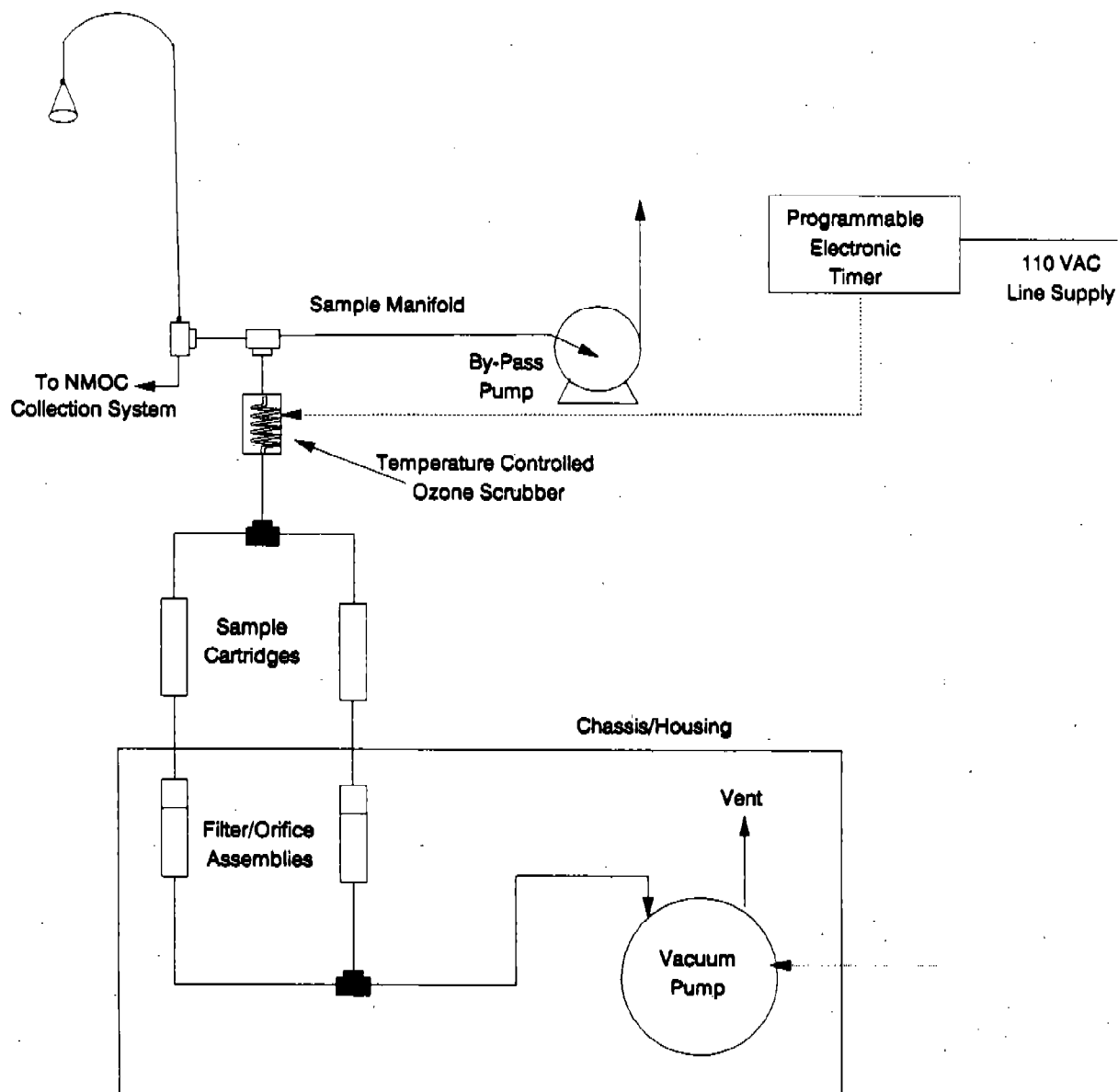
Figure 8-1. 3-Hour Carbonyl Sampling Subsytem

Ambient air was drawn from a glass manifold, through an ozone scrubber, and then through the carbonyl sample cartridges. The ozone scrubber was maintained at 200°F to prevent moisture condensation. The carbonyl samples were collected in duplicate parallel cartridges during each sample collection period. The carbonyl cartridges used were commercially available (Waters Co.) silica gel DNPH-coated Sep-Pak® cartridges.

The carbonyl cartridges were installed in the sampling sub-system one day prior to scheduled sample collection. A 3-hour sample collection period, concurrent with the NMOC canister collection, was utilized. In addition to the carbonyl cartridges installed in the sampling sub-system, a third cartridge was transported to the site as a trip blank or spare cartridge.

The flow rates through each of the duplicate carbonyl samples were controlled by flow restrictors (or critical orifices). The collection flow rates were quantified and the rotameters were calibrated before the sampling sub-systems were shipped to the sites. The volume of ambient air sampled through each cartridge was calculated in the Radian RTP laboratory based on the field-recorded sampling duration and flow rate information.

8.3 Analytical Procedures

The analytical procedures for carbonyls are given below. Sample preparation and analyses were performed at the Radian RTP laboratory. The preparation procedures of the cartridge samples are as follows:

- Remove cartridge from its shipping container.

- Attach cartridge to the end of a 10-mL glass syringe.

- Add 4 milliliters of acetonitrile to the syringe and catch drainage in a graduated centrifuge tube.

- After the syringe has finished draining, add acetonitrile to the graduated centrifuge tube until the total volume is 4 milliliters, and mix the solution.

- Transfer the solution in the graduated centrifuge tube to a 4-mL sample vial fitted with a Teflon®-lined self-sealing septum.

- Store the solution in a refrigerator until analysis.

The EPA Method TO-11[13] high pressure liquid chromatography (HPLC) column and elution solvents used for this analysis were modified to decrease analysis time, as shown in the following gradient elution, at a flow rate of 0.9 ml/min:

Time (Min.)	% Water	% Acetonitrile	% Methanol
0.0	40	20	40
12	25	5	70
18	23	5	72
28	15	10	75
32	40	20	40

For the analysis, 25 μl samples are injected with an automatic sampling injector. Compound separation is accomplished using a 25 cm x 4.6 mm C18 5-micron particle size analytical column. Output signals from a multi-wavelength ultraviolet (UV) detector are collected for 39 minutes at 360 nanometers (nm).

Chromatographic peaks for targeted compounds were determined by retention time, the area of the integrated peak, and concentrations calculated using calibration curves.

Target carbonyl compounds detected were formaldehyde, acetone, acetaldehyde, acrolein, propionaldehyde, crotonaldehyde, butyraldehyde, isobutyraldehyde, benzaldehyde, isovaleraldehyde, valeraldehyde, o-, m-, and p-tolualdehyde, hexanaldehyde and dimethylbenzaldehyde. All measured concentrations were reported in ppbv. The results for the field blanks were also reported in ppbv, assuming the same sample volume as the accompanying samples.

Instrument detection limits are given in Table 8-5 for the target carbonyl compounds in this study. The detection limits were determined by performing nine replicate analyses of a standard that was half the concentration of the lowest calibration standard, which follows the method listed in the Federal Register, Appendix B, Part 136.

8.4   Calibration Procedures

The HPLC was calibrated from 0.5 to 20 μg/ml nominal concentration of the derivatized targeted compounds contained in a solution of acetonitrile. The calibration curve consisted of five concentration levels between 0.5 to 20 μg/ml, and each was analyzed in replicate. A standard linear regression analysis was performed on the data for each analyte with the acceptance criteria being that the correlation coefficient must be greater than or equal to 0.995. Table 8-6 presents the calibration curve summary results. As indicated, the correlation coefficients for all compounds met the acceptance criteria.

8.4.1   Daily Quality Control Procedures

Daily calibration checks were used to ensure that the analytical procedures were in control. Daily QC checks were performed after every ten samples on each day that samples were analyzed. The QC standards analyzed during the program indicate that the analyses remained in control throughout the program as indicated in Table 8-7. There was a total of eight QC standards.

Table 8-5

Detection Limits for Target Carbonyl Compounds

Carbonyl	Underivatized Instrument Detection Limit (ppbv)[a]	CAS Number	AIRS Parameter Code
Formaldehyde	0.26	50-00-0	43502
Acetaldehyde	0.54	75-07-0	43503
Acrolein	0.42	107-02-8	43505
Acetone	0.37	67-64-1	43551
Propionaldehyde	0.40	123-38-6	43504
Crotonaldehyde	0.23	123-73-9	43516
Butyr/Isobutyraldehyde	0.29	NA	43329
Benzaldehyde	0.19	100-52-7	45501
Isovaleraldehyde	0.19	590-86-3	43513
Valeraldehyde	0.20	110-62-3	43518
Tolualdehyde	0.43	1334-78-7	45504
Hexanaldehyde	0.13	66-25-1	43517
2,5-Dimethylbenzaldehyde	0.22	5779-94-2	45503

[a]Detection limit is based upon an average 140 L sample.

Table 8-6

1993 NMOC Carbonyl Calibration Curve Summary

Analyte	Slope	Intercept	R	R$_2$	Relative Error				
					0.5 µg/ml (%)	1.0 µg/ml (%)	6.0 µg/ml (%)	12 µg/ml (%)	20 µg/ml (%)
Formaldehyde	1097704.88	-1601.58	0.99986	0.99972	3.73	-1.93	2.03	-1.77	0.46
Acetaldehyde	124828.69	9570.55	0.99992	0.99984	-2.06	-7.26	2.58	-0.61	0.01
Acrolein	141814.86	-2267.61	0.99976	0.99952	5.01	1.19	1.97	-2.47	0.71
Acetone	108101.04	2583.06	0.99986	0.99972	0.25	0.49	1.85	-1.74	0.46
Propionaldehyde	102718.21	7176.35	0.99979	0.99958	-8.11	-1.95	3.32	-1.70	0.32
Crotonaldehyde	129597.81	7889.09	0.99977	0.99953	-8.20	-8.50	3.43	-0.48	-0.11
Butyr/Isobutyraldehyde	95311.81	16255.25	0.99961	0.99922	-11.50	-9.83	3.64	-0.07	-0.27
Benzaldehyde	121777.63	16222.58	0.99981	0.99962	-14.56	-8.85	4.24	-0.48	-0.18
Isovaleraldehyde	82902.11	3636.09	0.99972	0.99944	-7.68	-8.09	4.30	-1.39	0.14
Valeraldehyde	92827.30	2536.40	0.99980	0.99959	-4.71	-3.51	2.81	-1.29	0.22
Tolualdehydes	112808.79	14871.74	0.99987	0.99975	-7.84	-8.81	3.36	-0.40	-0.13
Hexanaldehyde	83511.02	5904.29	0.99986	0.99972	-6.50	-8.22	3.70	-0.95	0.03
2,5-Dimethylbenzaldehyde	115747.45	7559.38	0.99983	0.99965	-6.58	-10.07	2.96	0.07	-0.26

Table 8-7

1993 NMOC Daily Quality Control Standards Recoveries

NMOC Sample ID Sample Volume (L) Data File ID Date Sampled Date Extracted Date Analyzed Dilution Factor	2nd Source QC NA RC327915 10/05/93 1.00	2nd Source QC NA RC327912 10/05/93 1.00	2nd Source QC NA RC327926 10/06/93 1.00	2nd Source QC NA RC327941 10/06/93 1.00	2nd Source QC NA RC327912 10/06/93 1.00	2nd Source QC NA RC327915 10/07/93 1.00	2nd Source QC NA RC327926 10/07/93 1.00	2nd Source QC NA RC327941 10/07/93 1.00
Percent Recoveries								
Formaldehyde	105.13	103.74	104.41	104.38	101.36	108.46	105.98	107.37
Acetaldehyde	99.86	98.99	99.63	98.39	102.32	102.50	100.89	103.00
Acrolein	108.35	107.36	108.88	106.52	112.31	113.39	112.57	111.76
Acetone	109.37	109.66	112.81	107.99	117.74	119.32	119.23	112.02
Propionaldehyde	100.55	109.68	114.53	101.26	115.62	124.09	120.80	103.66
Crotonaldehyde	112.05	108.18	111.33	110.65	114.22	114.18	113.08	115.88
Butyr/Isobutyraldehyde	112.93	113.71	115.59	111.67	115.50	120.30	118.90	120.56
Benzaldehyde	105.46	103.85	105.71	105.60	108.53	109.62	107.04	108.86
Isovaleraldehyde	ND[a]	ND	ND	ND	ND	ND	ND	ND
Valeraldehyde	100.80	101.26	99.97	99.62	102.11	95.33	94.71	108.84
Tolualdehydes	105.74	102.27	105.48	103.42	106.92	107.25	105.75	108.78
Hexanaldehyde	114.16	108.86	112.06	111.57	118.71	108.10	117.39	117.26
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	ND	ND	ND	ND

[a] ND = Not Detected.

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8.4.2 Duplicate Samples

Duplicate field samples were collected in duplicate cartridges during each sampling episode, as shown in Figure 8-1. One set of field duplicates from each site was prepared and analyzed in replicate to determine both the sampling and analytical precision.

8.4.3 Trip Blanks

A total of three DNPH cartridges were shipped to each site. Two cartridges were used to collect the sample, while the third tube, a trip blank, was used to assess the potential for field contamination. The blank cartridge accompanied the duplicate sample cartridges, but at no time was exposed to ambient air.

One trip blank cartridge from each site was analyzed for the target carbonyl analytes. The carbonyl sample results presented in this report are not blank corrected.

8.5   Quality Assurance/Quality Control Data

Quality assurance procedures relative to calibration data for all of the analytes and daily QC procedures are discussed below. Sampling and analysis precision was determined from the analysis of duplicate field samples and replicate laboratory analyses. Sample custody records were maintained throughout the program. Figure 8-2 shows the multipage field data and custody sheet used for carbonyl sampling documentation. The site operator's task involved recognizing problems with sampling equipment and procedures, and notifying Radian personnel so that appropriate corrective action might be taken. All Radian reported analyses were identified by the NMOC identification numbers which were recorded on the preformatted field data sheets when the samples were received.

RADIAN
CORPORATION

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Aldehyde Data Sheet

City _____ Sample Date _____

SAROAD No. _ _ · _ _ _ _ _ · _ _ _ ·A05   Sampler No. _____

Cartridge	Port A (red)	Port B (green)	(blank)
Tube No.	_____	_____	_____
Lot No.	_____	_____	_____

Rotameter No. _____

Rotameter Reading[1]_____ /_____ (before)   **Flow Rate[2]**   **LPM**

Rotameter Reading[1]_____ /_____ (after)   Before   _____

Sampling Time/Duration _____ (hours)   After   _____

Sampling Volume[3]_____ (liters)   Average   _____

Average Ambient Temperature _____ (C° or F°)

Average Barometric Pressure _____ (mm Hg)

Site Operator _____

Comments/Remarks _____

_____

_____

_____

_____

[1] Rotameter reading center of black ball.
[2] Calculated from calibration curve by the laboratory.
[3] Calculated by laboratory.

Sample Control Copy

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Figure 8-2. Carbonyl Field Data and Custody Sheet

8.5.1 Sampling Precision

The sampling precision was measured as the average standard deviation for the results from the field duplicate samples which were analyzed in replicate. The sampling precision results for PLNJ are given in Table 8-8. The sampling precision results for NWNJ site are given in Table 8-9. The duplicate analyses were performed on 10% of the samples from each site. The average standard deviation was 0.70 ppbv for PLNJ and 0.17 ppbv for the NWNJ.

8.5.2 Analytical Precision

The analytical precision was measured as the average standard deviation of the replicate analyses performed on the paired duplicate samples. The analytical precision results for PLNJ are given in Table 8-10. The analytical precision results for NWNJ are given in Table 8-11. The replicate analyses were performed on 10% of the samples from each site. The overall average standard deviation for all of the replicate analyses was 0.17 ppbv.

8.5.3 Quality Control Standards

As a QC procedure on the analytical results for all of the quantitated analytes, a solution containing 11 targeted carbonyl compounds at a known concentration was prepared. Quality control samples were analyzed after every 10 samples. Table 8-5 gives the percent recoveries for the QC standards that were analyzed during this program. Shown in Table 8-12 are the average, maximum, and minimum percent recovery and two standard deviations about the average percent recovery for each targeted carbonyl analyte. These results show that the analyses remained in control. The overall average percent recovery ranged from 94.71% for valeraldehyde to 124.09% for propionaldehyde.

Table 8-8

1993 NMOC Plainfield, New Jersey Sampling Precision Statistics

Dt Factor / NMOC ID / Data File ID / Date Sampled / Date Extracted / Date Analyzed	1 / 1222-A / RC32784 / 08/04/93 / 10/05/93 / 10/05/93	1 / 1222-A DUP / RC32785 / 08/04/93 / 10/05/93 / 10/05/93	1 / 1222-B / RC32786 / 08/04/93 / 10/05/93 / 10/05/93	1 / 1222-B DUP / RC32787 / 08/04/93 / 10/05/93 / 10/05/93	Average	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	7.46	8.24	8.98	9.26	8.49	0.70	8.24
Acetaldehyde	5.19	6.09	4.54	4.35	5.04	0.68	13.49
Acrolein	ND[a]	ND	ND	ND	NA[b]	NA	NA
Acetone	14.46	15.30	13.93	13.33	14.26	0.72	5.08
Propionaldehyde	ND	ND	0.47	0.34	NA	NA	NA
Crotonaldehyde	ND	ND	0.34	0.44	NA	NA	NA
Butyr/Isobutyraldehyde	ND	ND	0.94	ND	NA	NA	NA
Benzaldehyde	ND	ND	ND	ND	NA	NA	NA
Isovaleraldehyde	ND	ND	ND	ND	NA	NA	NA
Valeraldehyde	ND	ND	ND	ND	NA	NA	NA
Tolualdehydes	ND	ND	ND	ND	NA	NA	NA
Hexanaldehyde	ND	ND	0.42	0.48	NA	NA	NA
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	NA	NA	NA
					Average	0.70	8.94

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-9

1993 NMOC Newark, New Jersey Sampling Precision Statistics

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1 1535-A RC32794 08/04/93 10/05/93 10/06/93	1 1535-A DUP RC32795 08/04/93 10/05/93 10/06/93	1 1533-B RC32796 08/04/93 10/05/93 10/06/93	1 1533-B DUP RC32797 08/04/93 10/05/93 10/06/93	Average	Standard Deviation	Relative Standard Deviation
Formaldehyde	9.36	9.24	9.13	9.72	9.36	0.22	2.37
Acetaldehyde	4.05	4.25	3.99	4.08	4.09	0.10	2.36
Acrolein	ND[a]	ND	ND	ND	NA[b]	NA	NA
Acetone	13.34	13.96	13.04	13.80	13.54	0.37	2.70
Propionaldehyde	0.46	0.44	0.39	0.35	0.41	0.04	10.49
Crotonaldehyde	0.29	0.22	0.15	0.43	0.27	0.10	37.99
Butyr/Isobutryaldehyde	1.33	1.15	0.45	1.36	1.07	0.37	34.34
Benzaldehyde	ND	ND	ND	ND	NA	NA	NA
Isovaleraldehyde	ND	ND	ND	ND	NA	NA	NA
Valeraldehyde	0.43	0.48	0.42	0.56	0.47	0.06	11.72
Tolualdehydes	ND	ND	ND	ND	NA	NA	NA
Hexanaldehyde	0.96	0.85	1.06	1.15	1.01	0.11	11.14
2,5-Dimethylbenzaldehyde	ND	ND	ND	ND	NA	NA	NA
					Average	0.17	14.14

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-10

1993 NMOC Plainfield, New Jersey
Analytical Precision Statistics

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1.00 1222-A RC32784 08/04/93 10/05/93 10/05/93	1.00 1222-A DUP RC32785 08/04/93 10/05/93 10/05/93	Average	Absolute Percent Difference (%)	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	7.46	8.24	7.85	9.94	0.39	4.97
Acetaldehyde	5.19	6.09	5.64	15.96	0.45	7.98
Acrolein	ND[a]	ND	NA[b]	NA	NA	NA
Acetone	14.46	15.30	14.88	5.65	0.42	2.82
Propionaldehyde	ND	ND	NA	NA	NA	NA
Crotonaldehyde	ND	ND	NA	NA	NA	NA
Butyr/Isobutyraldehyde	ND	ND	NA	NA	NA	NA
Benzaldehyde	ND	ND	NA	NA	NA	NA
Isovaleraldehyde	ND	ND	NA	NA	NA	NA
Valeraldehyde	ND	ND	NA	NA	NA	NA
Tolualdehydes	ND	ND	NA	NA	NA	NA
Hexanaldehyde	ND	ND	NA	NA	NA	NA
2,5-Dimethylbenzaldehyde	ND	ND	NA	NA	NA	NA
			Average	10.51	0.42	5.26

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-10

Continued

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1.00 1222-B RC32786 08/04/93 10/05/93 10/05/93	1.00 1222-B DUP RC32787 08/04/93 10/05/93 10/05/93	Average	Absolute Percent Difference (%)	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	8.98	9.26	9.12	3.07	0.14	1.54
Acetaldehyde	4.54	4.35	4.45	4.27	0.10	2.14
Acrolein	ND[a]	ND	NA[b]	NA	NA	NA
Acetone	13.93	13.33	13.63	4.40	0.30	2.02
Propionaldehyde	0.47	0.34	0.41	32.10	0.06	16.05
Crotonaldehyde	0.34	0.44	0.39	25.64	0.05	12.82
Butyr/Isobutyraldehyde	0.94	ND	NA	NA	NA	NA
Benzaldehyde	ND	ND	NA	NA	NA	NA
Isovaleraldehyde	ND	ND	NA	NA	NA	NA
Valeraldehyde	ND	ND	NA	NA	NA	NA
Tolualdehydes	ND	ND	NA	NA	NA	NA
Hexanaldehyde	0.42	0.48	0.45	13.33	0.03	6.67
2,5-Dimethylbenzaldehyde	ND	ND	NA	NA	NA	NA
			Average	13.80	0.11	6.90

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-10

Continued

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1.00 1222-BLK RC32788 08/04/93 10/05/93 10/05/93	1.00 1222-BLK DUP RC32789 08/04/93 10/05/93 10/05/93	Average	Absolute Percent Difference (%)	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	7.52	7.67	7.60	1.97	0.08	0.99
Acetaldehyde	1.24	1.38	1.31	10.69	0.07	5.34
Acrolein	ND[a]	ND	NA[b]	NA	NA	NA
Acetone	3.11	3.32	3.22	6.53	0.10	3.27
Propionaldehyde	ND	ND	NA	NA	NA	NA
Crotonaldehyde	ND	ND	NA	NA	NA	NA
Butyr/Isobutyraldehyde	ND	ND	NA	NA	NA	NA
Benzaldehyde	ND	ND	NA	NA	NA	NA
Isovaleraldehyde	ND	ND	NA	NA	NA	NA
Valeraldehyde	ND	ND	NA	NA	NA	NA
Tolualdehydes	ND	ND	NA	NA	NA	NA
Hexanaldehyde	ND	ND	NA	NA	NA	NA
2,5-Dimethylbenzaldehyde	ND	ND	NA	NA	NA	NA
			Average	6.40	0.08	3.20

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-11

1993 NMOC Newark, New Jersey
Analytical Precision Statistics

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1.00 1533-A RC32794 08/04/93 10/05/93 10/06/93	1.00 1533-A DUP RC32795 08/04/93 10/05/93 10/06/93	Average	Absolute Percent Difference (%)	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	9.36	9.24	9.30	1.29	0.06	0.65
Acetaldehyde	4.05	4.25	4.15	4.82	0.10	2.41
Acrolein	ND[a]	ND	NA[b]	NA	NA	NA
Acetone	13.34	13.96	13.65	4.54	0.31	2.27
Propionaldehyde	0.46	0.44	0.45	4.44	0.01	2.22
Crotonaldehyde	0.29	0.22	0.26	27.45	0.03	1.75
Butyr/Isobutyraldehyde	1.33	1.15	1.24	14.52	0.09	4.50
Benzaldehyde	ND	ND	NA	NA	NA	NA
Isovaleraldehyde	ND	ND	NA	NA	NA	NA
Valeraldehyde	0.43	0.48	0.46	10.99	0.02	5.49
Tolualdehydes	ND	ND	NA	NA	NA	NA
Hexanaldehyde	0.96	0.85	0.91	12.15	0.06	6.08
2,5-Dimethylbenzaldehyde	ND	ND	NA	NA	NA	NA
			Average	10.03	0.09	3.17

[a]ND = Not Detected.
[b]NA = Not Applicable.

8-23

Table 8-11

Continued

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1.00 1533-B RC32796 08/04/93 10/05/93 10/06/93	1.00 1533-B DUP RC32797 08/04/93 10/05/93 10/06/93	Average	Absolute Percent Difference (%)	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	9.13	9.72	9.43	6.26	0.29	3.13
Acetaldehyde	3.99	4.08	4.04	2.23	0.04	1.12
Acrolein	ND[a]	ND	NA[b]	NA	NA	NA
Acetone	13.04	13.80	13.42	5.66	0.38	2.83
Propionaldehyde	0.39	0.35	0.37	10.81	0.02	5.415
Crotonaldehyde	0.15	0.43	0.29	96.55	0.14	48.28
Butyr/Isobutyraldehyde	0.45	1.36	0.91	100.55	0.46	50.28
Benzaldehyde	ND	ND	NA	NA	NA	NA
Isovaleraldehyde	ND	ND	NA	NA	NA	NA
Valeraldehyde	0.42	0.56	0.49	28.57	0.07	14.29
Tolualdehydes	ND	ND	NA	NA	NA	NA
Hexanaldehyde	1.06	1.15	1.11	8.14	0.04	4.07
2,5-Dimethylbenzaldehyde	ND	ND	NA	NA	NA	NA
			Average	32.35	0.18	16.17

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-11

Continued

DI Factor NMOC ID Data File ID Date Sampled Date Extracted Date Analyzed	1.00 1533-BLK RC32798 08/04/93 10/05/93 10/06/93	1.00 1533-BLK DUP RC32799 08/04/93 10/05/93 10/06/93	Average	Absolute Percent Difference (%)	Standard Deviation	Relative Standard Deviation (%)
Formaldehyde	ND[a]	ND	NA[b]	NA	NA	NA
Acetaldehyde	ND	ND	NA	NA	NA	NA
Acrolein	ND	ND	NA	NA	NA	NA
Acetone	0.48	0.49	0.49	48.75	0.49	48.69
Propionaldehyde	ND	ND	NA	NA	NA	NA
Crotonaldehyde	ND	ND	NA	NA	NA	NA
Butyr/Isobutyraldehyde	ND	ND	NA	NA	NA	NA
Benzaldehyde	ND	ND	NA	NA	NA	NA
Isovaleraldehyde	ND	ND	NA	NA	NA	NA
Valeraldehyde	ND	ND	NA	NA	NA	NA
Tolualdehydes	ND	ND	NA	NA	NA	NA
Hexanaldehyde	ND	ND	NA	NA	NA	NA
2,5-Dimethylbenzaldehyde	ND	ND	NA	NA	NA	NA
			Average	48.75	0.49	48.69

[a]ND = Not Detected.
[b]NA = Not Applicable.

Table 8-12

1993 NMOC Daily Quality Control Standards Statistics

Analyte	Average (%)	Standard Deviation	Maximum (%)	Minimum (%)	Avg + 2 * STD	Avg - 2 * STD
Formaldehyde	105.10	2.06	108.46	101.36	109.23	100.98
Acetaldehyde	100.70	1.63	103.00	98.39	103.96	97.43
Acrolein	110.14	2.49	113.39	106.52	115.11	105.17
Acetone	113.52	4.32	119.32	107.99	122.16	104.87
Propionaldehyde	111.27	8.37	124.09	100.55	128.01	94.54
Crotonaldehyde	112.45	2.27	115.88	108.18	116.98	107.91
Butyr/Isobutyraldehyde	116.15	3.19.	120.56	111.67	122.52	109.77
Benzaldehyde	106.83	1.88	109.62	103.85	110.60	103.07
Valeraldehyde	100.33	4.09	108.84	94.71	108.51	92.15
Toluraldehydes	105.70	1.95	108.78	102.27	109.60	101.80
Hexanaldehyde	113.51	3.76	118.71	108.10	121.04	105.99

9.0   SNMOC DATA SUMMARY

This section presents the data summary for the SNMOC portion of the
1993 NMOC monitoring program. Presented is information on the number of samples
collected, summary statistics, and individual sample results. For the 1993 SNMOC
monitoring program 686 valid ambient air samples were received; 756 sample analyses
were performed including 70 replicate analyses. The samples were analyzed by GC/FID
to determine concentrations of 78 target hydrocarbons. Table 9-1 presents the target
compounds. The samples were collected from 13 sites; 8 of these sites conducted daily
(Monday-Friday) sampling from 7 June to 30 September, 1993. Five sites participated in
an optional analysis program for which nine samples from each site collected for NMOC
analysis were randomly selected to receive analysis by the speciation method.
Appendix A presents the site information and the site codes used throughout this report.

9.1   Sample Collection Summary

Tables 9-2 and 9-3 summarize sample collection information for program and
option sites, respectively. Program sites were scheduled to collect samples from 7 June
to 30 September 1993.

9.2   Site Specific Summary Statistics

Site specific statistics are given in Tables 9-4 through 9-16. Duplicate and
duplicate/replicate results were averaged into single compound specific values for the
sample date and considered as one sample for summary statistics. The target compounds
for the 1993 monitoring season are given in the first column of the summary statistics
tables. The cases column denotes the number of samples the compound was identified
in for the 1993 monitoring season. The third column in the tables presents the percent
of the samples in which a particular compound was identified. The minimum, maximum,
median, average, standard deviation, skewness, and kurtosis of the measured
concentrations in ppbC are also listed in each table for each target compound. The

Table 9-1

1993 SNMOC Target Compounds

Compound	CAS Number	AIRS Parameter Code
Ethylene	74-86-1	43203
Acetylene	74-86-2	43206
Ethane	74-84-0	43202
Propyne	77-99-7	43144
Isobutane	75-28-5	43214
1-Butene	106-98-9	43280
Isobutene	115-11-7	43270
Propylene	115-07-1	43205
1,3-Butadiene	106-99-0	43218
n-Butane	106-97-8	43212
Propane	74-98-6	43204
t-2-Butene	624-64-6	43216
c-2-Butene	590-18-1	43217
3-Methyl-1-butene	563-45-1	43282
Isopentane	78-78-4	43221
1-Pentene	109-67-1	43224
2-Methyl-1-butene	563-46-2	43225
n-Pentane	109-66-0	43220
Isoprene	78-79-5	43243
t-2-Pentene	646-04-8	43226
c-2-Pentene	627-20-3	43227
2-Methyl-2-butene	513-35-9	43228
2,2-Dimethylbutane	75-83-2	43244
Cyclopentene	142-29-0	43283
4-Methyl-1-pentene	691-37-2	43234
Cyclopentane	287-92-3	43242
2,3-Dimethylbutane	79-29-8	43284
2-Methylpentane	107-83-5	43285

Table 9-1, continued

Compound	CAS Number	AIRS Parameter Code
3-Methylpentane	96-14-0	43230
2-Methyl-1-pentene	763-29-1	43246
1-Hexene	592-41-6	43245
2-Ethyl-1-butene	760-21-4	43236
n-Hexane	110-54-3	43231
t-2-Hexene	4050-47-7	43289
c-2-Hexene	7688-21-3	43290
Methylcyclopentane	96-37-7	43262
2,4-Dimethylpentane	108-08-7	43247
Benzene	71-43-2	45201
Cyclohexane	110-82-7	43248
2,3-Dimethylpentane	565-59-3	43291
2-Methylhexane	591-76-4	43263
3-Methylhexane	589-34-4	43249
2,2,4-Trimethylpentane	540-84-1	43250
n-Heptane	142-82-5	43232
Methylcyclohexane	108-87-2	43261
1-Heptene	592-76-7	43328
2,2,3-Trimethylpentane	564-02-3	43292
2,3,4-Trimethylpentane	565-75-3	43252
Toluene	108-88-3	45202
2-Methylheptane	592-27-8	43960
3-Methylheptane	589-81-1	43253
1-Octene	111-66-0	43145
n-Octane	111-65-9	43233
Ethylbenzene	100-41-4	45203
p-Xylene + m-Xylene	NA	45109
Styrene	100-42-5	45220

Table 9-1, continued

Compound	CAS Number	AIRS Parameter Code
o-Xylene	95-47-6	45204
1-Nonene	124-11-8	43279
n-Nonane	111-84-2	43235
Isopropylbenzene	98-82-8	45210
a-Pinene	7785-70-8	43256
n-Propylbenzene	103-65-1	45209
m-Ethyltoluene	620-14-4	45212
p-Ethyltoluene	622-96-8	45228
1,3,5-Trimethylbenzene	108-67-8	45207
o-Ethyltoluene	611-14-3	45211
b-Pinene	127-91-3	43257
1-Decene	872-05-9	43298
1,2,4-Trimethylbenzene	95-63-6	45208
n-Decane	124-18-5	43238
1,2,3-Trimethylbenzene	526-73-8	45225
p-Diethylbenzene	105-05-5	45219
1-Undecene	821-95-4	45299
n-Undecane	1120-21-4	43241
1-Dodecene	112-41-4	43330
n-Dodecane	112-40-3	43141
1-Tridecene	2437-56-1	43142
n-Tridecane	629-59-5	43143

Table 9-2

Samples Collected and Analyzed for 1993 SNMOC Program Sites

Site	Total Duplicate Samples	Total Replicate Analyses	Total Single Samples	Total Valid Sampling Events	Total Valid Samples	Total Analyses Reported
B1AL	16	8	74	82	90	98
B2AL	14	8	76	83	90	98
B3AL	16	12	58	66	74	86
BMTX	18	10	69	78	87	97
DLTX	16	8	74	82	90	98
EPTX	16	8	71	79	87	95
FWTX	16	8	72	80	88	96
JUMX	14	8	66	73	80	88
Total	126	70	560	623	686	756

Table 9-3

Samples Collected and Analyzed for 1993 SNMOC Option Sites

Site	Total Duplicate Samples	Total Replicate Analyses	Total Single Samples	Total Valid Samples	Total Analyses Reported
L1NY	2	1	7	9	10
NWNJ	2	1	7	9	10
P1PA	2	1	7	9	10
P2PA	2	1	8	10	11
PLNJ	2	1	7	9	10
Total	10	5	36	46	51

Table 9-4

1993 Summary Statistics for Birmingham, AL (B1AL)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	82	100.0	2.2	81.0	15.0	15.6	10.8	2.9	15.4
Acetylene	82	100.0	1.9	36.1	10.2	12.5	9.1	0.9	-0.1
Ethane	81	98.8	1.9	37.7	12.9	12.9	7.3	0.7	0.4
Propyne	0	0.00	.[a]	.	.	.	.	.	.
Isobutane	79	96.3	0.6	27.1	3.6	4.3	3.4	4.1	25.5
1-Butene	78	95.1	0.6	6.3	2.2	2.4	1.4	0.9	0.3
Isobutene	0	0.00	.	.	.	.	.	.	.
Propylene	82	100.0	1.2	17.6	5.3	6.1	4.0	0.8	-0.0
1,3-Butadiene	30	36.6	0.4	3.9	1.0	1.2	0.7	2.0	6.1
n-Butane	80	97.6	0.8	31.7	7.0	8.2	5.5	1.5	3.7
Propane	82	100.0	1.9	140.5	15.0	18.5	19.5	4.2	22.2
t-2-Butene	41	50.0	0.4	3.3	0.9	1.2	0.7	1.3	1.4
c-2-Butene	33	40.2	0.5	4.1	0.9	1.1	0.7	2.6	8.2
3-Methyl-1-butene	40	48.8	0.4	2.0	0.8	0.9	0.4	1.2	1.0
Isopentane	82	100.0	3.7	115.1	20.3	23.6	17.5	2.2	8.3
1-Pentene	58	70.7	0.4	10.3	1.1	1.7	1.9	2.9	9.0
2-Methyl-1-butene	73	89.0	0.4	5.7	1.3	1.6	1.0	1.4	3.2
n-Pentane	82	100.0	1.7	29.8	8.2	9.0	5.8	1.0	1.3
Isoprene	81	98.8	0.5	15.3	2.8	3.9	3.1	1.6	2.7
t-2-Pentene	73	89.0	0.6	6.7	2.0	2.1	1.3	0.9	0.9
c-2-Pentene	60	73.2	0.4	3.3	1.1	1.3	0.6	1.0	0.7
2-Methyl-2-butene	76	92.7	0.5	7.8	2.0	2.4	1.5	0.9	0.6
2,2-Dimethylbutane	76	92.7	0.4	28.7	8.9	8.4	5.4	0.8	1.6
Cyclopentene	42	51.2	0.5	1.6	0.7	0.8	0.3	1.2	0.5
4-Methyl-1-pentene	60	73.2	0.5	2.9	1.1	1.3	0.6	1.1	0.7
Cyclopentane	58	70.7	0.4	4.0	1.0	1.1	0.6	2.4	9.9
2,3-Dimethylbutane	77	93.9	0.6	6.5	2.3	2.6	1.5	0.5	-0.7

Table 9-4

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std. Dev[a]	S[a]	K[a]
2-Methylpentane	82	100.0	1.8	21.2	7.6	7.8	4.8	0.5	-0.8
3-Methylpentane	81	98.8	0.6	18.2	5.3	6.5	4.4	0.7	-0.4
2-Methyl-1-pentene	15	18.3	0.4	2.7	0.9	1.1	0.6	1.4	1.7
1-Hexene	39	47.6	0.5	2.8	1.3	1.3	0.5	0.9	1.1
2-Ethyl-1-butene	2	2.4	0.4	1.4	0.9	0.9	0.7	.	.
n-Hexane	81	98.8	1.1	22.1	5.0	6.2	4.6	1.0	0.6
t-2-Hexene	48	58.5	0.5	1.9	0.9	0.9	0.3	1.1	1.6
c-2-Hexene	33	40.2	0.5	1.2	0.7	0.7	0.2	1.1	0.8
Methylcyclopentane	82	100.0	0.6	9.4	2.8	3.3	2.1	0.6	-0.4
2,4-Dimethylpentane	74	90.2	0.4	7.1	1.9	2.1	1.3	1.0	1.9
Benzene	82	100.0	1.6	37.3	9.1	10.3	6.9	1.6	4.1
Cyclohexane	66	80.5	0.6	24.3	3.3	4.8	4.9	1.9	3.7
2,3-Dimethylpentane	44	53.7	0.4	4.6	1.6	1.7	1.0	0.8	0.2
2-Methylhexane	75	91.5	0.4	11.1	2.3	3.3	2.7	1.3	0.7
3-Methylhexane	82	100.0	1.0	8.9	3.5	3.7	1.9	0.4	-0.8
2,2,4-Trimethylpentane	82	100.0	0.9	18.5	6.0	6.5	4.3	0.7	-0.3
n-Heptane	78	95.1	0.5	5.9	2.4	2.5	1.4	0.5	-0.8
Methylcyclohexane	71	86.6	0.5	3.3	1.6	1.6	0.8	0.3	-1.1
1-Heptene	1	1.2	1.1	1.1	1.1	1.1	.	.	.
2,2,3-Trimethylpentane	61	74.4	0.5	2.7	1.2	1.2	0.5	0.3	-0.7
2,3,4-Trimethylpentane	78	95.1	0.6	6.4	2.3	2.5	1.6	0.6	-0.5
Toluene	82	100.0	4.7	58.3	22.1	23.0	12.9	0.5	-0.5
2-Methylheptane	74	90.2	0.5	3.5	1.6	1.6	0.8	0.4	-1.1
3-Methylheptane	67	81.7	0.5	3.1	1.3	1.4	0.7	0.5	-0.7
1-Octene	54	65.9	0.4	4.7	1.0	1.1	0.7	3.3	16.2
n-Octane	68	82.9	0.4	3.3	1.4	1.4	0.7	0.6	-0.1
Ethylbenzene	82	100.0	0.8	12.0	4.4	4.6	2.7	0.5	-0.6

Table 9-4

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	82	100.0	2.3	43.5	13.6	15.4	9.5	0.6	-0.3
Styrene	71	86.6	0.4	2.2	1.1	1.2	0.5	0.4	-0.8
o-Xylene	82	100.0	0.5	13.2	5.0	5.2	3.1	0.4	-0.7
1-Nonene	13	15.9	0.5	1.1	0.8	0.8	0.2	-0.1	-0.2
n-Nonane	68	82.9	0.5	3.5	1.5	1.6	0.7	0.4	-0.5
Isopropylbenzene	31	37.8	0.4	2.5	0.7	0.9	0.4	1.9	5.1
alpha-Pinene	64	78.1	0.5	13.8	1.2	2.0	2.0	3.6	18.1
n-Propylbenzene	64	78.1	0.5	3.8	1.3	1.4	0.7	1.0	1.0
m-Ethyltoluene	82	100.0	0.8	11.1	4.0	4.2	2.5	0.8	0.1
p-Ethyltoluene	51	62.2	0.5	3.4	1.2	1.2	0.6	1.1	1.9
1,3,5-Trimethylbenzene	71	86.6	0.6	10.8	2.2	2.5	1.6	2.4	10.0
o-Ethyltoluene	45	54.9	0.7	5.6	2.3	2.6	1.4	0.5	-0.8
beta-Pinene	66	80.5	0.5	8.1	1.4	1.7	1.3	2.5	9.2
1-Decene	81	98.8	0.4	10.8	1.3	2.7	2.7	1.5	1.0
1,2,4-Trimethylbenzene	78	95.1	1.0	16.2	3.3	5.7	3.7	1.1	0.4
n-Decane	71	86.6	0.4	43.5	1.8	2.7	5.4	6.8	50.1
1,2,3-Trimethylbenzene	79	96.3	0.7	9.9	3.5	3.8	2.2	0.8	0.1
p-Diethylbenzene	51	62.2	0.5	3.6	1.0	1.3	0.8	1.4	1.0
1-Undecene	65	79.3	0.4	4.9	1.1	1.3	0.8	2.1	5.8
n-Undecane	79	96.3	0.4	13.9	2.7	3.4	2.7	1.7	3.2
1-Dodecene	73	89.0	0.4	5.1	1.1	1.3	0.9	2.2	5.7
n-Dodecane	77	93.9	0.5	11.6	2.2	2.6	1.9	2.7	10.4
1-Tridecene	26	31.7	0.4	1.8	1.0	1.0	0.4	0.4	-0.8
n-Tridecane	75	91.5	0.5	3.6	1.1	1.2	0.6	1.9	4.2

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-5

1993 Summary Statistics for Birmingham, AL (B2AL)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	83	100.0	0.6	21.4	6.3	7.1	4.2	1.2	1.9
Acetylene	81	97.6	0.7	14.7	4.4	4.3	2.2	1.4	4.7
Ethane	79	95.2	0.9	10.4	4.8	5.0	2.0	0.5	0.3
Propyne	0	0.00	b						
Isobutane	66	79.5	0.6	60.2	1.6	3.4	8.9	5.6	32.3
1-Butene	74	89.2	0.5	3.6	1.4	1.5	0.6	0.8	1.1
Isobutene	0	0.00	.	.	.	.	.	.	.
Propylene	81	97.6	0.8	6.9	2.6	2.6	1.1	0.7	1.5
1,3-Butadiene	15	18.1	0.5	1.0	0.6	0.7	0.2	0.7	-0.7
n-Butane	81	97.6	1.0	49.2	3.0	5.0	8.5	4.6	20.9
Propane	83	100.0	1.4	13.6	6.7	6.6	2.6	0.5	0.2
t-2-Butene	24	28.9	0.4	3.9	1.1	1.4	0.9	1.3	1.3
c-2-Butene	7	8.4	0.4	4.5	0.6	1.3	1.4	2.3	5.5
3-Methyl-1-butene	12	14.5	0.6	2.7	1.1	1.2	0.6	1.6	2.6
Isopentane	83	100.0	1.7	668.2	7.9	24.1	83.8	6.6	46.9
1-Pentene	42	50.6	0.5	15.9	0.7	1.3	2.4	5.6	33.6
2-Methyl-1-butene	39	47.0	0.4	8.4	0.7	1.1	1.3	5.2	29.6
n-Pentane	83	100.0	0.7	162.7	3.1	6.4	18.4	7.8	65.0
Isoprene	81	97.6	0.7	14.0	4.9	5.1	3.3	0.8	0.3
t-2-Pentene	53	63.9	0.5	11.3	0.8	1.2	1.5	6.1	41.0
c-2-Pentene	23	27.7	0.4	6.0	0.8	1.0	1.1	4.3	19.3
2-Methyl-2-butene	66	79.5	0.4	13.0	0.9	1.3	1.6	6.7	50.1
2,2-Dimethylbutane	83	100.0	1.2	9.5	3.0	3.1	1.2	2.9	13.6
Cyclopentene	20	24.1	0.4	2.0	0.7	0.8	0.3	2.4	8.2
4-Methyl-1-pentene	39	47.0	0.4	2.6	1.0	1.1	0.6	1.3	1.3
Cyclopentane	18	21.7	0.4	22.1	0.8	3.0	6.1	2.8	6.8
2,3-Dimethylbutane	65	78.3	0.4	5.7	1.0	1.2	0.7	4.3	25.0

Table 9-5

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	81	97.6	0.7	16.7	2.6	3.1	2.2	3.4	18.7
3-Methylpentane	79	95.2	0.6	16.5	2.3	3.5	3.3	2.3	5.3
2-Methyl-1-pentene	19	22.9	0.4	2.9	0.8	1.1	0.7	1.3	1.6
1-Hexene	11	13.3	0.5	2.3	0.7	0.9	0.5	2.3	5.8
2-Ethyl-1-butene	2	2.4	0.6	0.6	0.6	0.6	0.0	.	.
n-Hexane	79	95.2	0.5	24.3	1.8	2.6	3.1	5.0	31.5
t-2-Hexene	9	10.8	0.5	1.8	0.6	0.9	0.5	1.5	0.5
c-2-Hexene	4	4.8	0.5	1.2	1.0	0.9	0.3	-1.0	-0.5
Methylcyclopentane	70	84.3	0.4	8.6	1.2	1.5	1.4	3.4	13.3
2,4-Dimethylpentane	53	63.9	0.4	2.9	0.8	0.9	0.4	2.5	9.7
Benzene	83	100.0	0.7	11.1	3.7	3.8	1.7	1.2	3.1
Cyclohexane	51	61.5	0.4	10.0	1.2	1.9	2.0	2.4	6.1
2,3-Dimethylpentane	23	27.7	0.4	1.9	0.8	0.9	0.3	1.5	2.6
2-Methylhexane	58	69.9	0.4	4.3	1.0	1.3	0.8	1.7	3.2
3-Methylhexane	81	97.6	0.6	10.0	1.6	1.9	1.3	4.2	21.6
2,2,4-Trimethylpentane	79	95.2	0.5	6.6	2.4	2.4	1.0	1.0	2.7
n-Heptane	51	61.5	0.4	6.9	0.8	1.1	1.1	4.1	19.2
Methylcyclohexane	34	41.0	0.4	3.8	0.7	1.0	0.8	2.6	6.7
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	24	28.9	0.4	2.9	0.6	0.7	0.5	4.1	18.5
2,3,4-Trimethylpentane	65	78.3	0.4	2.2	0.9	1.0	0.3	0.8	0.6
Toluene	83	100.0	1.4	98.5	6.9	10.4	16.4	4.8	23.0
2-Methylheptane	34	41.0	0.5	1.9	0.7	0.8	0.3	2.0	4.6
3-Methylheptane	21	25.3	0.4	1.3	0.6	0.6	0.2	2.0	3.2
1-Octene	15	18.1	0.5	2.3	0.7	0.9	0.6	2.0	2.8
n-Octane	33	39.8	0.4	1.5	0.7	0.8	0.3	1.1	0.7
Ethylbenzene	78	94.0	0.5	7.2	1.4	1.6	1.0	3.1	13.7

Table 9-5

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	83	100.0	0.7	19.1	4.2	4.6	2.9	2.2	7.9
Styrene	55	66.3	0.4	13.9	0.7	1.2	2.1	5.2	27.5
o-Xylene	80	96.4	0.5	6.9	1.7	1.8	1.0	2.3	9.6
1-Nonene	3	3.6	0.5	0.9	0.6	0.6	0.1	0.6	.
n-Nonane	33	39.8	0.5	2.1	0.8	0.9	0.5	1.4	0.6
Isopropylbenzene	6	7.2	0.5	1.1	0.8	0.8	0.2	0.3	-0.3
alpha-Pinene	47	56.6	0.5	12.6	4.0	4.5	3.1	0.6	-0.3
n-Propylbenzene	27	32.5	0.4	1.5	0.6	0.7	0.3	2.0	4.3
m-Ethyltoluene	82	98.8	0.5	8.0	2.5	3.0	1.8	0.8	-0.2
p-Ethyltoluene	10	12.1	0.4	3.2	0.7	1.0	0.9	2.0	3.6
1,3,5-Trimethylbenzene	63	75.9	0.4	2.9	0.9	0.9	0.4	2.4	9.3
o-Ethyltoluene	39	47.0	0.5	4.0	1.2	1.4	0.7	2.4	7.1
beta-Pinene	46	55.4	0.5	6.7	3.2	3.0	1.4	0.0	0.0
1-Decene	75	90.4	0.5	4.5	1.3	1.5	0.8	0.9	1.1
1,2,4-Trimethylbenzene	82	98.8	0.5	18.7	2.1	2.5	2.4	4.6	27.3
n-Decane	18	21.7	0.4	80.9	0.8	5.8	18.8	4.2	17.7
1,2,3-Trimethylbenzene	83	100.0	0.6	8.5	3.4	3.3	1.6	0.7	1.5
p-Diethylbenzene	21	25.3	0.4	1.5	0.6	0.7	0.3	1.5	1.7
1-Undecene	59	71.1	0.6	7.7	1.0	1.5	1.3	2.9	10.4
n-Undecane	70	84.3	0.5	536.1	1.4	10.0	63.9	8.3	69.6
1-Dodecene	68	81.9	0.5	8.0	0.8	1.1	1.0	5.0	30.9
n-Dodecane	76	91.6	0.6	471.4	1.3	9.1	54.0	8.6	74.6
1-Tridecene	21	25.3	0.5	0.9	0.5	0.6	0.1	1.4	0.9
n-Tridecane	69	83.1	0.4	59.4	0.9	2.3	7.2	7.6	60.8

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-6

1993 Summary Statistics for Birmingham, AL (B3AL)

| Compound | Cases | Freq[a] (%) | ppbC | | | | | | |
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	62	93.9	0.9	21.1	6.5	7.5	5.0	0.8	0.1
Acetylene	60	90.9	0.8	9.6	2.5	3.3	2.2	1.1	0.6
Ethane	66	100.0	0.8	23.0	6.4	6.8	3.8	1.8	5.8
Propyne	0	0.0	.[b]	.	.	.	.	.	.
Isobutane	58	87.9	0.5	19.5	2.4	3.3	3.0	3.1	13.7
1-Butene	57	86.4	0.5	4.0	1.3	1.4	0.7	1.2	2.0
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	64	97.0	0.6	10.5	2.0	2.5	1.8	2.1	6.4
1,3-Butadiene	10	15.2	0.5	1.1	0.5	0.6	0.2	2.1	5.0
n-Butane	65	98.5	1.0	83.3	5.4	10.6	13.7	3.2	12.5
Propane	66	100.0	1.8	380.1	6.9	12.8	46.0	8.1	65.4
t-2-Butene	23	34.9	0.6	4.1	1.1	1.4	0.9	1.8	3.7
c-2-Butene	22	33.3	0.6	2.9	1.3	1.2	0.6	1.1	1.9
3-Methyl-1-butene	22	33.3	0.5	2.6	0.9	1.1	0.5	1.5	3.1
Isopentane	66	100.0	1.8	89.5	12.2	19.1	20.7	2.1	3.7
1-Pentene	46	69.7	0.4	4.1	0.9	1.3	0.8	1.7	2.7
2-Methyl-1-butene	44	66.7	0.4	5.4	1.1	1.4	1.1	2.0	4.7
n-Pentane	66	100.0	0.5	24.6	4.4	6.1	5.7	1.9	3.1
Isoprene	65	98.5	0.6	27.9	4.8	7.1	6.2	1.5	2.1
t-2-Pentene	47	71.2	0.5	5.7	1.2	1.7	1.4	1.6	2.0
c-2-Pentene	35	53.0	0.4	3.2	0.9	1.1	0.7	1.5	1.8
2-Methyl-2-butene	50	75.8	0.5	7.8	1.3	1.9	1.7	2.0	3.7
2,2-Dimethylbutane	59	89.4	0.6	16.8	8.0	7.7	3.2	0.3	0.5
Cyclopentene	20	30.3	0.4	3.0	0.7	0.9	0.6	3.3	12.7
4-Methyl-1-pentene	39	59.1	0.5	2.8	1.1	1.2	0.6	1.3	1.7
Cyclopentane	31	47.0	0.4	2.6	0.9	1.0	0.6	1.5	2.0
2,3-Dimethylbutane	56	84.9	0.4	6.9	1.3	1.9	1.5	1.9	2.9

Table 9-6

Continued

Compound	Cases	Freq (%)	ppbC						
			Min	Max	Med	Avg	Std Dev	S	K
2-Methylpentane	66	100.0	0.8	17.9	3.2	4.3	3.7	1.8	3.3
3-Methylpentane	63	95.5	0.7	17.3	3.0	3.7	3.0	2.1	6.4
2-Methyl-1-pentene	16	24.2	0.5	1.7	1.1	0.9	0.4	0.4	-0.5
1-Hexene	17	25.8	0.5	1.7	0.8	0.9	0.4	1.0	-0.1
2-Ethyl-1-butene	5	7.6	0.5	1.3	1.0	0.9	0.3	-0.0	-0.5
n-Hexane	64	97.0	0.5	7.3	2.0	2.3	1.6	1.4	1.8
t-2-Hexene	15	22.7	0.4	1.5	0.7	0.8	0.3	1.5	3.5
c-2-Hexene	6	9.1	0.5	0.7	0.7	0.6	0.1	-0.8	-1.4
Methylcyclopentane	56	84.9	0.5	4.6	1.3	1.6	0.9	1.5	2.4
2,4-Dimethylpentane	45	68.2	0.4	3.7	0.9	1.2	0.7	1.9	3.6
Benzene	66	100.0	0.9	11.3	3.5	4.1	2.4	0.8	0.3
Cyclohexane	32	48.5	0.4	3.5	1.1	1.2	0.8	1.6	2.3
2,3-Dimethylpentane	31	47.0	0.4	2.8	0.8	1.0	0.6	1.4	1.5
2-Methylhexane	47	71.2	0.4	2.8	1.0	1.1	0.6	1.4	1.4
3-Methylhexane	65	98.5	0.6	4.2	1.8	2.0	0.9	0.7	-0.4
2,2,4-Trimethylpentane	65	98.5	0.7	8.6	2.5	3.0	2.0	1.1	0.5
n-Heptane	43	65.2	0.4	2.2	1.0	1.1	0.5	0.9	0.3
Methylcyclohexane	30	45.5	0.5	2.4	0.9	1.0	0.5	1.6	2.3
1-Heptene	2	3.03	0.78	0.89	0.84	0.84	0.08		
2,2,3-Trimethylpentane	30	45.5	0.4	2.5	0.7	0.8	0.4	3.2	13.9
2,3,4-Trimethylpentane	50	75.8	0.5	2.7	1.1	1.2	0.6	0.9	0.1
Toluene	66	100.0	2.3	71.4	8.3	10.6	9.6	4.1	24.4
2-Methylheptane	28	42.4	0.4	1.1	0.7	0.7	0.2	0.5	-0.6
3-Methylheptane	24	36.4	0.5	1.3	0.7	0.73	0.2	0.9	0.9
1-Octene	27	40.9	0.4	0.9	0.6	0.6	0.2	0.8	-0.3
n-Octane	28	42.4	0.4	2.4	0.8	0.9	0.5	2.0	4.2
Ethylbenzene	60	90.9	0.5	42.9	1.3	2.2	5.4	7.5	57.7

Table 9-6

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	66	100.0	0.9	129.2	3.8	6.1	15.6	7.8	62.9
Styrene	41	62.1	0.4	1.4	0.7	0.8	0.2	0.7	-0.1
o-Xylene	60	90.9	0.5	28.3	1.4	2.1	3.6	7.1	52.7
1-Nonene	4	6.1	0.4	1.2	0.6	0.7	0.3	1.6	2.4
n-Nonane	29	43.9	0.4	2.9	0.8	1.0	0.6	2.2	-4.7
Isopropylbenzene	6	9.1	0.7	1.1	0.8	0.8	0.2	1.1	1.2
alpha-Pinene	42	63.6	0.5	21.9	3.9	5.4	5.5	1.7	2.8
n-Propylbenzene	22	33.3	0.4	2.2	0.6	0.7	0.4	2.4	6.7
m-Ethyltoluene	65	98.5	0.7	8.8	2.2	2.6	1.7	1.9	3.9
p-Ethyltoluene	17	25.8	0.4	1.9	0.5	0.6	0.4	3.6	13.8
1,3,5-Trimethylbenzene	39	59.1	0.5	2.3	1.0	1.1	0.4	0.9	0.8
o-Ethyltoluene	39	59.1	0.6	2.5	1.2	1.3	0.5	0.7	0.0
beta-Pinene	48	72.7	0.6	8.4	2.5	2.8	1.8	1.0	1.0
1-Decene	62	93.9	0.5	5.0	1.2	1.4	0.9	1.9	3.8
1,2,4-Trimethylbenzene	64	97.0	0.5	11.6	1.8	2.5	2.1	2.2	6.2
n-Decane	38	57.6	0.4	47.7	0.8	2.9	8.2	4.8	25.2
1,2,3-Trimethylbenzene	65	98.5	0.7	5.3	2.2	2.4	1.1	0.9	0.5
p-Diethylbenzene	19	28.8	0.4	2.4	0.6	0.9	0.6	1.6	2.0
1-Undecene	48	72.7	0.5	8.5	1.1	1.6	1.6	3.2	11.2
n-Undecane	62	93.9	0.4	8.9	1.1	1.8	1.7	2.6	6.9
1-Dodecene	56	84.9	0.5	4.6	0.9	1.2	1.0	2.3	4.5
n-Dodecane	62	93.9	0.4	9.5	1.3	1.8	1.9	2.8	7.9
1-Tridecene	13	19.7	0.4	3.1	0.6	0.9	0.7	2.7	7.5
n-Tridecane	54	81.8	0.4	3.4	0.9	1.2	0.8	1.5	1.4

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-7

1993 Summary Statistics for Beaumont, Texas (BMTX)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	78	100.0	0.6	146.0	17.7	33.8	36.2	1.6	2.0
Acetylene	74	94.9	0.6	42.9	5.3	8.1	8.2	2.3	6.4
Ethane	78	100.0	4.5	79.8	25.4	28.2	16.2	0.9	0.8
Propyne	0	0.0	.[b]	.	.	.	.	.	.
Isobutane	78	100.0	0.9	143.0	15.6	20.7	22.5	3.8	18.0
1-Butene	74	94.9	0.5	38.4	2.8	4.1	5.2	4.7	27.5
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	76	97.4	0.7	64.4	4.7	9.9	11.3	2.3	6.8
1,3-Butadiene	36	46.2	0.5	3.7	1.0	1.2	0.7	1.7	3.4
n-Butane	78	100.0	2.8	502.4	20.5	36.3	64.7	5.7	37.1
Propane	78	100.0	4.2	532.6	28.8	77.0	131.8	2.7	6.0
t-2-Butene	49	62.8	0.5	32.5	1.5	2.5	4.7	5.9	37.9
c-2-Butene	52	66.7	0.5	24.4	1.1	2.0	3.5	5.6	35.9
3-Methyl-1-butene	47	60.3	0.4	10.9	1.1	1.6	1.7	4.2	22.2
Isopentane	78	100.0	4.5	875.8	31.9	63.6	118.3	5.3	32.3
1-Pentene	62	79.5	0.5	19.6	1.4	2.5	3.4	3.4	12.6
2-Methyl-1-butene	67	85.9	0.6	32.7	1.7	2.7	4.2	5.9	40.2
n-Pentane	78	100.0	2.2	436.1	13.5	28.4	58.1	5.7	35.4
Isoprene	66	84.6	0.6	7.1	2.1	2.5	1.6	1.2	0.9
t-2-Pentene	67	85.9	0.6	28.0	2.2	3.3	3.9	4.4	24.3
c-2-Pentene	60	76.9	0.5	15.2	1.5	2.1	2.2	4.2	22.0
2-Methyl-2-butene	74	94.9	0.7	40.6	2.5	3.9	5.4	4.9	30.2
2,2-Dimethylbutane	78	100.0	0.9	8.7	3.3	3.6	1.3	1.1	2.2
Cyclopentene	40	51.3	0.4	4.3	0.7	0.9	0.7	3.5	16.0
4-Methyl-1-pentene	40	51.3	0.5	3.5	0.7	0.9	0.6	3.0	11.8
Cyclopentane	72	92.3	0.6	24.3	1.9	2.8	3.4	4.6	24.5
2,3-Dimethylbutane	76	97.4	0.5	31.2	2.5	3.6	4.2	4.7	26.7

Table 9-7

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	78	100.0	1.3	83.2	8.4	13.1	14.1	3.1	11.1
3-Methylpentane	78	100.0	0.7	59.5	7.1	8.7	8.5	3.8	18.7
2-Methyl-1-pentene	13	16.7	0.4	2.9	0.7	1.0	0.8	1.9	3.0
1-Hexene	43	55.1	0.5	6.4	1.1	1.5	1.3	2.2	5.4
2-Ethyl-1-butene	1	1.3	0.8	0.9	0.9	0.9	.	.	.
n-Hexane	78	100.0	0.9	78.3	8.0	11.0	11.1	3.8	18.6
t-2-Hexene	33	42.3	0.5	3.5	0.7	0.8	0.6	3.8	16.7
c-2-Hexene	18	23.1	0.4	2.0	0.6	0.7	0.4	2.6	7.8
Methylcyclopentane	78	100.0	0.6	35.0	4.1	5.3	5.1	3.6	17.0
2,4-Dimethylpentane	67	85.9	0.5	10.1	1.1	1.4	1.3	5.4	36.0
Benzene	78	100.0	0.9	42.0	6.7	8.3	6.2	2.9	11.5
Cyclohexane	74	94.9	0.6	14.7	3.3	3.8	2.8	2.1	5.6
2,3-Dimethylpentane	33	42.3	0.5	2.9	0.9	1.1	0.6	1.8	3.2
2-Methylhexane	75	96.2	0.7	17.7	2.3	2.9	2.3	3.7	20.8
3-Methylhexane	76	97.4	0.9	11.2	3.0	3.4	1.9	2.0	5.4
2,2,4-Trimethylpentane	77	98.7	0.8	49.5	4.5	5.4	5.8	6.1	46.4
n-Heptane	76	97.4	0.7	30.5	2.8	3.6	3.9	4.8	29.8
Methylcyclohexane	77	98.7	0.5	15.7	2.9	3.7	3.0	2.2	5.7
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	57	73.1	0.5	4.8	0.8	1.0	0.6	4.6	27.5
2,3,4-Trimethylpentane	70	89.7	0.5	11.7	1.7	2.0	1.5	4.4	27.3
Toluene	78	100.0	1.8	325.0	13.8	19.0	36.1	8.1	69.1
2-Methylheptane	65	83.3	0.5	4.7	1.3	1.5	0.8	1.7	3.6
3-Methylheptane	61	78.2	0.6	2.9	1.0	1.1	0.5	1.6	3.3
1-Octene	31	39.7	0.4	2.1	0.6	0.8	0.4	2.2	5.5
n-Octane	68	87.2	0.4	6.4	1.2	1.5	1.1	2.0	5.1
Ethylbenzene	75	96.2	0.7	11.2	2.5	2.8	1.5	2.4	10.8

Table 9-7

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	78	100.0	0.9	25.1	6.6	7.2	4.2	1.5	4.1
Styrene	59	75.6	0.5	5.9	0.9	1.7	1.6	1.4	0.4
o-Xylene	76	97.4	0.8	8.6	2.5	2.8	1.5	1.2	2.1
1-Nonene	5	6.4	0.5	1.0	0.5	0.6	0.3	1.9	3.5
n-Nonane	63	80.8	0.5	8.2	1.0	1.3	1.1	4.0	21.0
Isopropylbenzene	28	35.9	0.4	2.1	0.7	0.8	0.3	2.5	8.7
alpha-Pinene	52	66.7	0.6	13.5	1.8	3.0	3.4	2.2	3.6
n-Propylbenzene	53	68.0	0.5	1.6	0.9	0.9	0.3	0.6	-0.6
m-Ethyltoluene	76	97.4	0.5	10.3	2.3	2.9	2.3	1.8	3.2
p-Ethyltoluene	34	43.6	0.4	2.0	0.8	0.9	0.4	1.1	1.2
1,3,5-Trimethylbenzene	61	78.2	0.5	13.4	1.3	1.6	1.7	6.4	46.1
o-Ethyltoluene	33	42.3	0.5	2.9	1.5	1.6	0.7	0.3	-1.1
beta-Pinene	46	59.0	0.5	5.8	1.0	1.8	1.6	1.2	0.2
1-Decene	72	92.3	0.5	7.2	1.7	2.3	1.7	1.0	0.3
1,2,4-Trimethylbenzene	69	88.5	0.7	6.6	1.8	2.4	1.7	1.1	0.3
n-Decane	69	88.5	0.4	20.4	1.2	1.9	2.7	5.4	34.0
1,2,3-Trimethylbenzene	73	93.6	0.6	8.0	2.7	3.1	1.9	0.7	-0.3
p-Diethylbenzene	30	38.5	0.5	29.6	0.7	2.0	5.3	5.2	27.4
1-Undecene	62	79.5	0.5	16.4	1.0	1.5	2.1	6.5	47.0
n-Undecane	77	98.7	0.6	8.3	1.6	2.0	1.4	2.0	5.3
1-Dodecene	70	89.7	0.5	1.9	0.9	1.0	0.4	0.9	-0.1
n-Dodecane	75	96.2	0.5	18.7	1.5	2.2	2.6	4.5	24.1
1-Tridecene	18	23.1	0.4	2.7	0.6	0.7	0.5	3.8	15.1
n-Tridecane	65	83.3	0.4	7.4	0.8	1.2	1.1	4.0	19.6

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-8

1993 Summary Statistics for Dallas, Texas (DLTX)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	80	97.6	0.8	48.6	8.8	10.1	7.3	2.7	11.7
Acetylene	81	98.8	0.9	31.6	5.4	7.0	5.8	2.1	5.3
Ethane	82	100.0	0.8	49.9	10.7	12.7	8.3	1.6	4.0
Propyne	0	0.0	.[b]	.	.	.	.	.	.
Isobutane	76	92.7	0.7	215.3	3.5	6.5	24.4	8.6	74.8
1-Butene	79	96.3	0.6	8.6	1.7	2.0	1.3	2.6	8.6
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	81	98.8	0.7	16.1	3.1	3.6	2.5	2.5	8.1
1,3-Butadiene	28	34.2	0.5	2.9	0.7	0.9	0.6	2.2	5.3
n-Butane	82	100.0	1.7	38.5	7.3	8.5	6.3	2.4	7.9
Propane	82	100.0	2.6	68.3	14.2	16.3	11.0	2.3	7.6
t-2-Butene	27	32.9	0.5	2.8	0.9	1.2	0.6	1.2	1.1
c-2-Butene	25	30.5	0.5	2.8	0.7	1.0	0.6	2.0	4.7
3-Methyl-1-butene	20	24.4	0.4	4.6	0.7	1.1	1.0	2.6	6.6
Isopentane	82	100.0	4.0	817.1	13.1	25.4	89.3	8.8	79.2
1-Pentene	50	61.0	0.5	5.1	1.0	1.2	0.9	3.3	12.1
2-Methyl-1-butene	53	64.6	0.4	4.2	1.1	1.3	0.8	1.8	3.8
n-Pentane	82	100.0	1.3	26.3	5.5	6.3	4.2	2.4	7.8
Isoprene	73	89.0	0.4	3.4	1.2	1.4	0.6	1.1	0.9
t-2-Pentene	72	87.8	0.5	6.7	1.2	1.5	1.2	2.9	9.0
c-2-Pentene	44	53.7	0.4	3.4	0.8	1.0	0.6	2.2	4.8
2-Methyl-2-butene	78	95.1	0.5	9.2	1.4	1.7	1.3	3.4	15.1
2,2-Dimethylbutane	82	100.0	1.2	19.1	6.5	7.5	3.3	1.1	1.7
Cyclopentene	18	22.0	0.5	1.5	0.8	0.8	0.3	1.0	0.3
4-Methyl-1-pentene	32	39.0	0.5	2.3	1.0	1.0	0.5	0.9	0.5
Cyclopentane	47	57.3	0.4	29.7	0.8	1.8	4.3	6.1	39.3
2,3-Dimethylbutane	73	89.0	0.6	7.7	1.5	1.8	1.3	2.7	8.6

Table 9-8

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	82	100.0	1.4	25.1	4.5	5.4	4.1	2.7	8.6
3-Methylpentane	82	100.0	0.9	20.1	3.3	4.2	3.3	2.4	7.5
2-Methyl-1-pentene	12	14.6	0.5	2.0	0.6	0.9	0.5	1.6	1.6
1-Hexene	24	29.3	0.5	2.3	0.7	0.9	0.5	1.5	1.6
2-Ethyl-1-butene	2	2.4	0.5	0.7	0.6	0.6	0.1	.	.
n-Hexane	82	100.0	0.7	33.7	2.9	3.7	4.2	5.2	33.6
t-2-Hexene	19	23.2	0.4	4.4	0.6	1.0	0.9	3.0	9.8
c-2-Hexene	10	12.2	0.5	1.0	0.6	0.7	0.2	1.0	0.6
Methylcyclopentane	80	97.6	0.7	19.7	1.6	2.0	2.3	5.9	42.4
2,4-Dimethylpentane	56	68.3	0.5	4.7	0.8	1.2	0.8	2.7	7.9
Benzene	82	100.0	0.9	23.6	4.0	5.0	3.5	2.8	10.4
Cyclohexane	48	58.5	0.4	13.4	1.0	1.4	1.9	5.9	38.6
2,3-Dimethylpentane	23	28.1	0.6	3.9	1.0	1.2	0.9	2.4	5.6
2-Methylhexane	79	96.3	0.6	15.7	1.6	2.2	2.1	4.3	24.4
3-Methylhexane	82	100.0	1.0	12.5	2.3	3.0	2.0	2.9	10.2
2,2,4-Trimethylpentane	82	100.0	0.8	22.7	3.3	4.3	3.7	3.0	10.2
n-Heptane	75	91.5	0.5	15.9	1.6	2.2	2.3	3.9	19.3
Methylcyclohexane	69	84.2	0.4	92.2	1.2	2.7	11.0	8.2	68.2
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	48	58.5	0.4	3.7	0.8	1.0	0.7	2.4	5.2
2,3,4-Trimethylpentane	78	95.1	0.5	8.9	1.3	1.7	1.5	3.0	10.0
Toluene	82	100.0	3.1	198.0	11.7	18.1	25.2	5.2	33.0
2-Methylheptane	62	75.6	0.5	5.6	1.0	1.3	0.9	3.0	10.5
3-Methylheptane	48	58.5	0.5	4.1	0.9	1.1	0.8	2.5	6.1
1-Octene	26	31.7	0.4	2.3	0.7	1.0	0.6	1.1	0.1
n-Octane	54	65.9	0.4	4.6	0.8	1.1	0.8	3.1	11.1
Ethylbenzene	81	98.8	0.8	12.9	1.9	2.6	2.3	2.9	8.8

Table 9-8

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	82	100.0	1.8	40.9	6.0	7.9	7.1	3.0	9.7
Styrene	49	59.8	0.4	21.6	0.7	1.4	3.0	6.7	45.7
o-Xylene	81	98.8	0.5	15.8	2.3	3.0	2.6	3.0	10.3
1-Nonene	3	3.7	0.6	2.2	1.0	1.3	0.9	1.4	.
n-Nonane	50	61.0	0.4	12.7	0.9	1.5	1.9	4.8	27.0
Isopropylbenzene	12	14.6	0.5	3.5	0.8	1.1	0.8	2.3	5.6
alpha-Pinene	46	56.1	0.6	7.1	1.3	1.5	1.1	3.5	16.6
n-Propylbenzene	56	68.3	0.4	8.1	0.8	1.1	1.1	4.7	26.7
m-Ethyltoluene	80	97.6	0.8	11.6	1.9	2.3	1.9	2.9	9.8
p-Ethyltoluene	55	67.1	0.5	6.4	0.8	1.2	1.2	3.3	11.4
1,3,5-Trimethylbenzene	67	81.7	0.5	11.9	1.3	1.6	1.5	5.2	34.0
o-Ethyltoluene	33	40.2	0.6	58.6	1.5	3.3	10.0	5.7	32.3
beta-Pinene	26	31.7	0.5	4.9	0.8	1.2	10.0	2.8	8.4
1-Decene	79	96.3	0.5	20.9	1.9	2.9	3.0	3.7	18.0
1,2,4-Trimethylbenzene	79	96.3	0.6	17.8	1.9	2.7	2.7	3.6	16.4
n-Decane	61	74.4	0.4	44.6	1.0	2.2	5.7	7.1	53.4
1,2,3-Trimethylbenzene	80	97.6	0.7	14.1	1.8	2.3	1.9	3.4	18.4
p-Diethylbenzene	23	28.1	0.4	4.6	0.7	0.9	0.8	4.2	18.8
1-Undecene	55	67.1	0.5	9.4	1.1	1.4	1.3	5.2	31.8
n-Undecane	75	91.5	0.5	9.1	1.2	1.6	1.4	3.1	12.3
1-Dodecene	66	80.5	0.5	3.1	0.9	1.1	0.5	2.1	5.3
n-Dodecane	78	95.1	0.5	13.9	1.3	1.9	2.2	3.9	16.1
1-Tridecene	19	23.2	0.5	1.5	0.6	0.7	0.3	2.3	5.8
n-Tridecane	69	84.2	0.5	4.0	0.8	1.0	0.5	3.5	16.5

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-9

1993 Summary Statistics for El Paso, Texas (EPTX)

| Compound | Cases | Freq[a] (%) | ppbC | | | | | | |
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	79	100.0	4.9	49.9	19.0	20.4	8.9	0.8	1.0
Acetylene	79	100.0	4.6	42.8	14.8	15.6	6.9	1.1	2.1
Ethane	77	97.5	0.6	82.6	10.5	13.0	11.0	3.8	21.3
Propyne	0	0.0	[b]	.	.	.	.	.	.
Isobutane	77	97.5	1.3	25.8	5.1	6.8	5.0	1.5	2.1
1-Butene	79	100.0	1.3	13.7	3.8	4.2	2.0	1.8	5.8
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	79	100.0	2.4	21.4	7.6	8.2	3.5	1.4	3.1
1,3-Butadiene	55	69.6	0.5	2.7	1.4	1.4	0.5	0.4	-0.5
n-Butane	78	98.7	2.6	82.9	12.8	16.8	13.2	2.3	7.6
Propane	79	100.0	2.2	305.3	21.7	36.0	41.7	3.9	22.2
t-2-Butene	64	81.0	0.6	3.4	1.5	1.6	0.7	0.7	-0.5
c-2-Butene	71	89.9	0.5	4.1	1.1	1.3	0.7	1.8	4.6
3-Methyl-1-butene	40	50.6	0.4	2.2	0.7	0.8	0.4	1.8	4.1
Isopentane	78	98.7	7.0	152.9	20.4	26.6	20.4	3.6	18.7
1-Pentene	74	93.7	0.4	6.9	1.1	1.4	1.0	3.3	14.3
2-Methyl-1-butene	76	96.2	0.6	4.7	1.5	1.8	0.8	1.2	1.3
n-Pentane	79	100.0	4.3	52.2	12.3	15.5	9.2	1.7	3.2
Isoprene	58	73.4	0.4	2.2	0.8	0.9	0.3	1.6	4.0
t-2-Pentene	79	100.0	0.6	5.0	1.9	2.2	1.2	0.9	0.4
c-2-Pentene	73	92.4	0.6	4.1	1.1	1.3	0.7	1.6	3.6
2-Methyl-2-butene	79	100.0	0.8	7.0	2.5	2.9	1.4	1.0	0.7
2,2-Dimethylbutane	79	100.0	3.2	43.5	8.1	9.8	6.5	2.5	8.8
Cyclopentene	33	41.8	0.4	1.1	0.7	0.7	0.2	0.8	-0.4
4-Methyl-1-pentene	57	72.2	0.4	1.6	0.8	0.8	0.2	1.3	2.0
Cyclopentane	76	96.2	0.5	4.6	1.4	1.6	0.8	1.2	1.7
2,3-Dimethylbutane	79	100.0	0.9	8.0	2.6	2.8	1.5	1.2	1.5

Table 9-9

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	79	100.0	3.0	26.7	8.2	9.4	4.7	1.3	1.9
3-Methylpentane	79	100.0	2.1	27.7	5.8	6.8	3.9	2.4	10.0
2-Methyl-1-pentene	14	17.7	0.5	1.7	0.7	0.8	0.4	1.5	2.1
1-Hexene	58	73.4	0.5	2.4	1.0	1.1	0.4	1.0	0.6
2-Ethyl-1-butene	1	1.3	0.9	0.9	0.9	0.9	.	.	.
n-Hexane	79	100.0	2.6	23.9	6.8	7.8	3.9	1.5	2.9
t-2-Hexene	46	58.2	0.4	1.5	0.8	0.8	0.2	1.0	0.9
c-2-Hexene	31	39.2	0.5	1.2	0.6	0.7	0.2	1.2	0.5
Methylcyclopentane	79	100.0	1.7	16.1	4.8	5.5	2.7	1.4	2.5
2,4-Dimethylpentane	79	100.0	0.9	7.0	2.6	3.0	1.4	1.0	0.7
Benzene	79	100.0	4.4	31.7	12.0	13.2	5.6	1.2	1.7
Cyclohexane	79	100.0	0.5	8.0	2.6	2.9	1.5	0.9	0.8
2,3-Dimethylpentane	76	96.2	1.1	10.3	3.2	3.7	2.0	1.4	1.9
2-Methylhexane	79	100.0	0.7	13.0	2.0	2.6	1.8	2.9	12.8
3-Methylhexane	79	100.0	2.0	11.9	4.0	4.6	1.9	1.3	2.2
2,2,4-Trimethylpentane	79	100.0	2.7	19.9	7.3	8.1	3.7	1.0	0.8
n-Heptane	79	100.0	0.8	9.2	3.0	3.4	1.8	1.1	0.8
Methylcyclohexane	79	100.0	0.8	5.9	2.1	2.3	1.0	1.0	0.9
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	72	91.1	0.5	2.8	1.1	1.2	0.5	1.1	0.8
2,3,4-Trimethylpentane	79	100.0	0.9	6.7	2.6	2.8	1.2	1.0	0.9
Toluene	79	100.0	10.8	84.4	27.2	30.6	13.8	1.3	2.4
2-Methylheptane	78	98.7	0.6	5.4	1.8	2.1	1.0	1.2	1.4
3-Methylheptane	77	97.5	0.6	4.9	1.5	1.7	0.8	1.5	2.8
1-Octene	61	77.2	0.5	3.9	1.1	1.2	0.6	1.9	5.9
n-Octane	79	100.0	0.6	4.1	1.1	1.4	0.7	1.5	2.4
Ethylbenzene	79	100.0	2.2	16.9	5.6	6.2	2.8	1.4	2.6

Table 9-9

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	79	100.0	0.5	38.3	14.9	16.2	6.9	0.8	0.8
Styrene	79	100.0	0.5	2.9	1.3	1.4	0.5	1.0	0.6
o-Xylene	79	100.0	2.2	15.7	5.6	6.1	2.7	1.2	2.0
1-Nonene	44	55.7	0.4	1.7	0.8	0.8	0.3	1.4	2.7
n-Nonane	75	94.9	0.7	14.9	1.8	2.3	1.9	4.2	24.8
Isopropylbenzene	53	67.1	0.4	2.3	0.8	0.9	0.4	1.1	1.0
alpha-Pinene	67	84.8	0.6	6.6	1.8	2.0	1.1	2.0	5.7
n-Propylbenzene	78	98.7	0.6	5.0	1.5	1.7	0.8	1.5	2.8
m-Ethyltoluene	79	100.0	1.2	11.2	3.8	4.3	1.9	1.2	1.5
p-Ethyltoluene	77	97.5	0.7	4.4	1.5	1.7	0.8	1.4	2.2
1,3,5-Trimethylbenzene	79	100.0	0.6	6.2	2.3	2.5	1.3	0.8	0.1
o-Ethyltoluene	36	45.6	1.4	29.1	2.7	3.7	4.6	5.1	28.3
beta-Pinene	51	64.6	0.4	4.8	1.0	1.2	0.8	2.3	7.5
1-Decene	76	96.2	0.6	15.8	3.5	4.4	3.8	1.1	0.3
1,2,4-Trimethylbenzene	79	100.0	0.7	50.5	4.6	6.4	7.0	3.8	20.8
n-Decane	77	97.5	0.5	30.0	2.2	3.2	3.9	5.0	31.0
1,2,3-Trimethylbenzene	79	100.0	0.9	15.1	3.1	3.5	2.2	2.4	9.5
p-Diethylbenzene	45	57.0	0.4	3.4	1.1	1.3	0.6	1.1	1.4
1-Undecene	70	88.6	0.5	7.7	1.2	1.4	1.0	4.3	25.9
n-Undecane	79	100.0	0.6	27.5	2.6	3.4	3.5	4.8	28.9
1-Dodecene	76	96.2	0.4	3.3	1.1	1.2	0.6	1.1	0.9
n-Dodecane	79	100.0	0.7	59.4	1.7	3.3	7.2	6.6	48.5
1-Tridecene	31	39.2	0.4	1.8	0.8	0.9	0.3	1.0	0.4
n-Tridecane	76	96.2	0.5	12.3	1.0	1.4	1.6	5.2	31.7

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-10

1993 Summary Statistics for Fort Worth, Texas (FWTX)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	79	98.8	0.9	47.7	7.7	9.7	7.6	2.4	8.1
Acetylene	79	98.8	1.2	33.4	3.5	5.8	5.8	2.5	7.4
Ethane	79	98.8	0.7	61.2	8.6	11.0	9.6	2.9	10.7
Propyne	0	0.0	.b	.	.	.	.	.	.
Isobutane	74	92.5	0.6	28.2	2.8	4.1	4.6	3.5	14.7
1-Butene	77	96.3	0.5	12.0	1.5	2.0	1.8	3.5	14.7
Isobutene	1	1.3	1.8	1.8	1.8	1.8	.	.	.
Propylene	80	100.0	0.6	16.5	2.0	2.9	2.7	2.8	9.1
1,3-Butadiene	17	21.3	0.4	2.3	1.0	1.0	0.5	1.2	2.2
n-Butane	80	100.0	1.6	161.0	6.0	11.0	21.4	5.6	34.7
Propane	80	100.0	3.5	72.3	9.9	13.7	11.9	3.0	12.0
t-2-Butene	21	26.3	0.5	18.9	0.9	2.0	3.9	4.4	19.7
c-2-Butene	18	22.5	0.4	20.4	0.8	2.2	4.6	4.1	16.8
3-Methyl-1-butene	18	22.5	0.4	7.7	1.0	1.5	1.7	3.1	10.5
Isopentane	80	100.0	4.3	236.6	9.4	18.2	31.1	5.3	32.8
1-Pentene	34	42.5	0.4	11.6	0.8	1.6	2.1	3.9	17.7
2-Methyl-1-butene	52	65.0	0.5	18.7	0.9	1.7	2.6	5.8	37.4
n-Pentane	80	100.0	1.7	85.4	4.1	8.5	12.2	4.0	20.4
Isoprene	56	70.0	0.5	2.1	1.0	1.1	0.5	0.7	-0.6
t-2-Pentene	64	80.0	0.4	20.2	1.0	1.7	2.7	5.6	37.2
c-2-Pentene	31	38.8	0.4	10.8	0.7	1.5	2.0	4.0	18.5
2-Methyl-2-butene	71	88.8	0.5	34.3	1.0	2.0	4.1	7.0	54.6
2,2-Dimethylbutane	80	100.0	3.6	85.5	8.8	18.0	17.2	1.7	2.8
Cyclopentene	10	12.5	0.5	3.3	0.8	1.0	0.8	2.9	8.9
4-Methyl-1-pentene	33	41.3	0.4	2.8	1.0	1.0	0.5	1.8	3.9
Cyclopentane	42	52.5	0.4	8.5	0.8	1.4	1.6	3.1	10.9
2,3-Dimethylbutane	70	87.5	0.4	15.4	1.2	1.9	2.3	4.1	19.6

Table 9-10

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	80	100.0	1.3	43.9	3.3	5.5	6.6	3.7	16.6
3-Methylpentane	80	100.0	0.8	26.3	2.6	3.9	4.2	3.2	12.1
2-Methyl-1-pentene	24	30.0	0.5	1.8	0.9	1.0	0.5	0.5	-1.2
1-Hexene	14	17.5	0.4	3.4	1.0	1.2	0.8	1.7	3.7
2-Ethyl-1-butene	0	0.0	.	.	.	.	.	.	.
n-Hexane	80	100.0	0.8	22.3	2.2	3.4	3.4	3.2	12.8
t-2-Hexene	16	20.0	0.5	2.2	0.8	0.9	0.4	1.8	3.8
c-2-Hexene	9	11.3	0.5	1.5	0.7	0.8	0.3	2.0	4.6
Methylcyclopentane	78	97.5	0.7	12.2	1.3	2.0	1.9	3.2	11.8
2,4-Dimethylpentane	45	56.3	0.4	5.7	0.8	1.3	1.1	2.4	6.2
Benzene	79	98.8	0.9	23.5	3.3	4.6	4.2	2.7	8.0
Cyclohexane	48	60.0	0.5	2.7	1.3	1.4	0.6	0.5	-0.8
2,3-Dimethylpentane	19	23.8	0.6	3.4	1.0	1.4	0.9	1.4	1.0
2-Methylhexane	74	92.5	0.6	10.2	1.6	2.0	1.8	2.6	7.4
3-Methylhexane	80	100.0	0.9	9.4	2.0	2.6	1.8	2.3	4.9
2,2,4-Trimethylpentane	79	98.8	0.9	26.0	2.6	4.5	4.9	2.9	9.0
n-Heptane	73	91.3	0.4	7.4	1.2	1.7	1.5	2.4	5.2
Methylcyclohexane	64	80.0	0.4	4.6	0.9	1.3	0.9	1.8	2.7
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	42	52.5	0.4	4.1	0.8	1.1	0.9	1.9	3.2
2,3,4-Trimethylpentane	75	93.8	0.5	9.6	1.0	1.7	1.7	2.8	8.3
Toluene	80	100.0	1.2	68.5	8.1	12.6	12.0	2.7	7.6
2-Methylheptane	56	70.0	0.4	4.3	0.9	1.2	0.9	2.0	3.3
3-Methylheptane	42	52.5	0.4	3.4	0.7	1.1	0.8	1.8	2.0
1-Octene	20	25.0	0.4	2.2	0.9	1.0	0.5	1.2	1.6
n-Octane	42	52.5	0.5	4.8	0.8	1.1	0.8	2.7	9.2
Ethylbenzene	77	96.3	0.6	10.8	1.5	2.2	2.0	2.5	6.2

Table 9-10

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	79	98.8	1.0	37.1	4.7	7.1	6.5	2.7	7.5
Styrene	42	52.5	0.4	4.8	0.8	1.1	0.9	2.9	9.7
o-Xylene	77	96.3	0.5	14.6	1.8	2.7	2.5	2.7	7.7
1-Nonene	0	0.0	.	.	.	.	.	.	.
n-Nonane	37	46.3	0.4	1.9	0.7	0.8	0.4	1.3	0.9
Isopropylbenzene	14	17.5	0.6	1.5	0.8	0.9	0.3	1.0	0.3
alpha-Pinene	48	60.0	0.6	3.1	1.7	1.6	0.6	0.4	0.3
n-Propylbenzene	45	56.3	0.4	3.2	0.8	1.0	0.6	1.9	3.3
m-Ethyltoluene	76	95.0	0.7	10.5	1.6	2.2	1.8	2.3	6.2
p-Ethyltoluene	40	50.0	0.4	4.4	0.7	1.1	0.9	2.0	4.0
1,3,5-Trimethylbenzene	61	76.3	0.5	6.3	1.0	1.3	1.1	2.6	7.9
o-Ethyltoluene	36	45.0	0.5	4.8	1.3	1.6	0.8	2.7	9.5
beta-Pinene	28	35.0	0.4	3.3	0.9	1.1	0.6	2.0	5.2
1-Decene	74	92.5	0.6	18.1	1.4	2.6	3.1	2.9	9.6
1,2,4-Trimethylbenzene	72	90.0	0.6	13.6	1.7	2.2	2.0	3.7	17.3
n-Decane	51	63.8	0.4	4.1	0.9	1.1	0.7	2.4	7.9
1,2,3-Trimethylbenzene	76	95.0	0.6	16.4	2.1	2.4	2.4	4.4	23.1
p-Diethylbenzene	25	31.3	0.4	1.5	0.7	0.8	0.3	1.0	0.2
1-Undecene	57	71.3	0.5	4.1	1.3	1.4	0.8	1.3	2.0
n-Undecane	77	96.3	0.4	19.8	1.1	1.8	2.4	5.7	40.3
1-Dodecene	68	85.0	0.4	2.8	1.0	1.1	0.5	1.8	2.6
n-Dodecane	74	92.5	0.5	22.4	1.5	2.7	3.6	3.4	13.0
1-Tridecene	22	27.5	0.4	1.2	0.6	0.7	0.2	0.8	-0.3
n-Tridecane	69	86.3	0.5	5.9	0.9	1.2	1.0	3.0	10.5

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-11

1993 Summary Statistics for Juarez, Mexico (JUMX)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	68	91.9	1.7	62.6	9.7	11.7	9.7	3.0	12.5
Acetylene	71	96.0	1.5	60.1	7.2	9.2	8.6	3.7	18.7
Ethane	72	97.3	1.3	61.9	7.7	10.7	10.0	2.9	11.1
Propyne	0	0.0	.[b]	.	.	.	.	.	.
Isobutane	70	94.6	0.8	109.8	4.4	8.4	15.5	5.1	29.5
1-Butene	69	93.3	0.5	12.9	1.9	2.5	1.8	3.5	16.9
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	73	98.7	0.8	30.5	3.7	4.4	4.1	4.1	23.4
1,3-Butadiene	22	29.7	0.4	2.9	0.8	1.0	0.7	1.9	3.7
n-Butane	73	98.7	1.6	92.1	12.9	17.5	16.6	2.3	6.3
Propane	73	98.7	3.2	297.6	44.7	60.5	55.2	2.1	5.5
t-2-Butene	26	35.1	0.5	4.6	1.1	1.5	1.0	1.5	2.8
c-2-Butene	27	36.5	0.5	4.1	1.0	1.2	0.8	2.0	4.6
3-Methyl-1-butene	19	25.7	0.5	2.6	0.8	1.0	0.6	1.6	2.2
Isopentane	73	98.7	1.0	859.5	10.7	32.9	107.0	6.9	51.3
1-Pentene	42	56.8	0.5	23.0	1.1	1.7	3.4	6.3	40.0
2-Methyl-1-butene	40	54.1	0.4	8.1	1.0	1.4	1.3	3.9	18.2
n-Pentane	73	98.7	0.7	73.8	7.1	11.7	13.9	2.8	8.2
Isoprene	57	77.0	0.5	3.3	1.2	1.3	0.7	1.1	0.8
t-2-Pentene	44	59.5	0.6	7.9	1.2	1.6	1.4	2.7	8.2
c-2-Pentene	28	37.8	0.5	4.6	0.9	1.3	1.0	2.3	5.8
2-Methyl-2-butene	53	71.6	0.6	9.8	1.2	1.9	1.7	2.7	8.6
2,2-Dimethylbutane	73	98.7	4.3	20.4	8.8	9.2	2.6	1.4	4.3
Cyclopentene	6	8.1	0.5	2.0	0.9	1.1	0.6	0.9	-0.2
4-Methyl-1-pentene	23	31.1	0.5	1.1	0.7	0.7	0.2	0.7	0.5
Cyclopentane	47	63.5	0.5	6.6	0.9	1.4	1.3	2.4	6.0
2,3-Dimethylbutane	61	82.4	0.5	10.1	1.4	1.8	1.5	3.5	17.6

Table 9-11

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	73	98.7	0.7	38.5	4.0	5.6	5.4	3.6	18.8
3-Methylpentane	71	96.0	0.7	25.1	3.1	4.4	4.0	2.7	9.8
2-Methyl-1-pentene	13	17.6	0.4	2.1	0.9	1.3	0.7	0.3	-1.9
1-Hexene	22	29.7	0.4	4.3	0.7	0.9	0.8	4.0	16.9
2-Ethyl-1-butene	0	0.0	.	.	.	.	.	.	.
n-Hexane	72	97.3	0.7	37.4	3.5	5.0	5.2	3.9	21.7
t-2-Hexene	13	17.6	0.5	4.1	0.6	0.9	1.0	3.3	11.5
c-2-Hexene	7	9.5	0.5	2.3	0.6	0.9	0.7	2.4	6.1
Methylcyclopentane	70	94.6	0.5	22.6	2.1	3.1	3.1	4.2	23.8
2,4-Dimethylpentane	62	83.8	0.5	10.1	1.3	1.7	1.4	3.9	20.4
Benzene	73	98.7	0.9	46.4	4.9	6.5	6.3	4.0	22.3
Cyclohexane	62	83.8	0.4	19.4	1.5	2.4	2.9	4.3	21.7
2,3-Dimethylpentane	62	83.8	0.5	10.3	1.7	2.1	1.8	2.7	8.6
2-Methylhexane	62	83.8	0.5	7.2	1.3	1.8	1.4	2.1	4.8
3-Methylhexane	73	98.7	0.8	16.6	2.6	3.4	2.7	2.8	9.9
2,2,4-Trimethylpentane	70	94.6	0.6	25.0	3.0	4.0	3.8	3.3	14.2
n-Heptane	68	91.9	0.5	14.6	1.8	2.3	2.2	3.4	14.7
Methylcyclohexane	58	78.4	0.6	6.9	1.3	1.6	1.2	2.5	7.7
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	35	47.3	0.4	4.4	0.8	1.0	0.7	3.7	17.1
2,3,4-Trimethylpentane	59	79.7	0.4	9.7	1.2	1.5	1.4	4.1	22.3
Toluene	73	98.7	1.8	164.7	13.7	21.3	26.3	3.6	15.4
2-Methylheptane	50	67.6	0.4	5.4	1.1	1.4	0.9	2.5	7.8
3-Methylheptane	51	68.9	0.5	14.1	0.9	2.2	3.0	2.6	6.7
1-Octene	24	32.4	0.5	5.3	1.1	1.8	1.5	1.2	0.1
n-Octane	52	70.3	0.4	8.5	1.1	1.8	2.0	2.3	4.7
Ethylbenzene	73	98.7	0.6	47.4	2.9	4.7	6.4	4.7	28.4

Table 9-11

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	73	98.7	0.8	134.2	7.3	12.3	17.6	5.1	32.3
Styrene	61	82.4	0.4	9.1	0.9	1.6	1.8	3.0	9.6
o-Xylene	71	96.0	0.6	45.5	2.8	4.5	6.3	4.6	26.3
1-Nonene	20	27.0	0.4	6.1	0.8	1.8	1.6	1.3	1.2
n-Nonane	52	70.3	0.5	10.8	0.9	1.5	1.9	4.2	18.4
Isopropylbenzene	25	33.8	0.5	9.7	1.0	2.4	2.6	1.5	1.3
alpha-Pinene	48	64.9	0.6	22.3	2.0	2.8	3.4	4.2	22.3
n-Propylbenzene	49	66.2	0.5	7.8	1.0	1.2	1.1	5.2	31.0
m-Ethyltoluene	71	96.0	0.6	18.5	1.8	2.4	2.3	5.1	33.3
p-Ethyltoluene	37	50.0	0.5	6.2	0.9	1.3	1.2	3.1	9.5
1,3,5-Trimethylbenzene	57	77.0	0.6	16.0	1.1	2.5	3.5	2.6	6.6
o-Ethyltoluene	31	41.9	0.6	11.6	1.3	1.8	2.0	4.5	22.4
beta-Pinene	21	28.4	0.4	3.0	1.0	1.2	0.6	1.6	3.3
1-Decene	74	100.0	0.5	9.6	2.0	2.4	1.7	1.8	4.1
1,2,4-Trimethylbenzene	74	100.0	0.4	31.6	1.6	2.7	3.8	6.1	44.9
n-Decane	64	86.5	0.5	12.4	1.1	1.9	2.3	3.4	12.4
1,2,3-Trimethylbenzene	71	96.0	0.5	13.3	1.8	2.2	2.0	3.8	17.8
p-Diethylbenzene	28	37.8	0.4	2.8	1.1	1.1	0.6	1.2	2.4
1-Undecene	55	74.3	0.5	3.4	1.1	1.3	0.7	1.3	1.0
n-Undecane	71	96.0	0.6	23.0	1.7	3.1	4.3	3.5	12.5
1-Dodecene	65	87.8	0.4	2.8	1.0	1.1	0.5	1.4	2.3
n-Dodecane	73	98.7	0.6	38.6	1.5	3.6	6.5	4.1	17.2
1-Tridecene	22	29.7	0.4	1.8	0.8	0.9	0.5	1.0	-0.3
n-Tridecane	66	89.2	0.5	13.9	1.1	1.7	2.2	3.8	17.3

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average; Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-12

1993 Summary Statistics for Long Island, New York (LINY)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	8	100.0	5.0	17.9	8.7	9.9	4.4	0.9	-0.2
Acetylene	8	100.0	2.0	6.9	4.8	4.5	1.7	-0.4	-0.5
Ethane	8	100.0	3.5	15.2	7.0	7.6	3.6	1.4	2.7
Propyne	1	12.5	0.7	0.7	0.7	0.7	b	.	.
Isobutane	8	100.0	1.6	7.3	3.9	4.3	2.1	0.4	-1.2
1-Butene	8	100.0	1.0	3.9	2.5	2.4	1.0	0.0	-0.4
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	8	100.0	1.6	6.0	3.7	3.6	1.4	0.1	-0.4
1,3-Butadiene	2	25.0	0.5	0.8	0.7	0.7	0.2	.	.
n-Butane	8	100.0	2.8	12.2	8.4	7.7	3.5	-0.2	-1.7
Propane	8	100.0	4.9	42.4	5.5	10.6	12.9	2.8	7.7
t-2-Butene	7	87.5	0.5	1.7	1.2	1.2	0.4	-1.1	2.5
c-2-Butene	6	75.0	0.6	1.5	1.0	1.0	0.3	0.1	0.5
3-Methyl-1-butene	3	37.5	0.6	0.7	0.7	0.7	0.1	-0.2	.
Isopentane	8	100.0	5.5	29.3	15.7	15.4	7.4	0.7	0.8
1-Pentene	5	62.50	0.59	1.96	0.70	1.00	0.57	1.68	2.61
2-Methyl-1-butene	7	87.50	0.63	1.54	1.20	1.11	0.32	-0.29	-0.88
n-Pentane	8	100.0	1.6	8.4	4.9	4.7	2.1	0.4	0.7
Isoprene	8	100.0	0.4	4.4	1.1	1.8	1.6	1.3	-0.2
t-2-Pentene	7	87.5	0.7	1.8	1.3	1.3	0.4	-0.3	-1.3
c-2-Pentene	7	87.5	0.5	1.0	0.8	0.8	0.2	-0.4	-1.4
2-Methyl-2-butene	8	100.0	0.6	1.9	1.3	1.3	0.4	-0.6	-0.3
2,2-Dimethylbutane	4	50.0	0.5	0.6	0.5	0.5	0.1	-0.8	0.3
Cyclopentene	1	12.5	0.8	0.8	0.8	0.8	.	.	.
4-Methyl-1-pentene	5	62.5	0.4	1.3	0.5	0.7	0.4	2.1	4.5
Cyclopentane	5	62.5	0.5	1.0	0.7	0.7	0.2	0.3	-2.2
2,3-Dimethylbutane	8	100.0	0.8	2.5	1.2	1.4	0.6	1.2	1.0

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Table 9-12

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	8	100.0	1.5	9.3	3.5	4.5	3.0	1.2	-0.2
3-Methylpentane	8	100.0	1.9	6.4	3.1	3.6	1.5	0.9	-0.1
2-Methyl-1-pentene	1	12.5	0.8	0.8	0.8	0.8	.	.	.
1-Hexene	4	50.0	0.5	0.8	0.5	0.6	0.2	1.9	3.8
2-Ethyl-1-butene	0	0.0	.	.	.	.	.	.	.
n-Hexane	8	100.0	0.9	3.5	2.0	2.0	0.8	0.6	0.3
t-2-Hexene	1	12.5	0.4	0.4	0.4	0.4	.	.	.
c-2-Hexene	1	12.5	0.5	0.5	0.5	0.5	.	.	.
Methylcyclopentane	8	100.0	0.6	2.7	1.4	1.4	0.6	1.20	3.1
2,4-Dimethylpentane	7	87.5	0.4	1.4	0.7	0.8	0.3	1.2	2.4
Benzene	8	100.0	2.6	9.3	5.5	5.5	2.0	0.5	1.2
Cyclohexane	7	87.5	0.6	2.0	1.2	1.1	0.5	0.5	-0.3
2,3-Dimethylpentane	3	37.5	0.5	1.0	0.8	0.8	0.3	-0.9	.
2-Methylhexane	8	100.0	0.8	2.6	1.6	1.7	0.7	0.2	-1.8
3-Methylhexane	8	100.0	1.1	3.9	2.2	2.3	0.8	0.9	1.9
2,2,4-Trimethylpentane	8	100.0	0.9	5.5	2.9	2.8	1.4	0.7	0.8
n-Heptane	7	87.5	0.7	2.4	1.3	1.5	0.6	0.6	-1.1
Methylcyclohexane	8	100.0	0.5	1.3	0.7	0.8	0.3	1.8	4.0
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	6	75.0	0.5	1.0	0.6	0.7	0.2	1.2	0.5
2,3,4-Trimethylpentane	8	100.0	0.5	2.1	1.2	1.2	0.5	0.6	0.7
Toluene	8	100.0	6.3	36.1	14.0	15.6	9.0	2.0	5.1
2-Methylheptane	8	100.0	0.4	1.9	0.7	0.9	0.5	1.3	0.9
3-Methylheptane	5	62.5	0.6	1.5	0.8	0.9	0.4	2.1	4.5
1-Octene	3	37.5	0.5	0.7	0.5	0.6	0.1	1.2	.
n-Octane	4	50.0	0.6	1.4	0.8	0.9	0.4	0.8	-1.5
Ethylbenzene	8	100.0	1.0	4.6	1.9	2.2	1.1	1.8	4.1

Table 9-12

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	8	100.0	3.1	15.6	7.2	7.5	3.7	1.6	3.7
Styrene	6	75.0	0.5	0.8	0.6	0.6	0.1	0.2	-1.1
o-Xylene	8	100.0	1.1	5.3	2.4	2.5	1.3	1.4	3.1
1-Nonene	2	25.0	0.5	0.6	0.5	0.5	0.1	.	.
n-Nonane	7	87.5	0.6	1.9	0.6	0.9	0.5	1.6	2.3
Isopropylbenzene	2	25.0	0.5	0.5	0.5	0.5	0.0	.	.
alpha-Pinene	8	100.0	0.6	3.0	1.1	1.4	0.8	1.2	0.3
n-Propylbenzene	6	75.0	0.6	1.4	0.6	0.7	0.3	2.4	5.6
m-Ethyltoluene	8	100.0	1.0	4.0	1.9	2.2	1.1	1.0	-0.5
p-Ethyltoluene	4	50.0	0.5	1.1	0.6	0.7	0.3	1.9	3.7
1,3,5-Trimethylbenzene	8	100.0	0.6	2.1	1.0	1.1	0.5	1.3	2.1
o-Ethyltoluene	7	87.5	0.7	2.5	1.6	1.5	0.6	0.1	-0.4
beta-Pinene	2	25.0	0.6	1.5	1.0	1.0	0.6	.	.
1-Decene	8	100.0	0.7	3.4	1.1	1.4	0.9	2.2	5.2
1,2,4-Trimethylbenzene	8	100.0	0.8	7.2	2.8	3.0	2.0	1.5	3.2
n-Decane	6	75.0	0.6	1.3	0.9	0.9	0.2	0.7	0.3
1,2,3-Trimethylbenzene	8	100.0	1.8	6.2	3.2	3.7	1.5	0.6	-0.9
p-Diethylbenzene	3	37.5	0.6	0.7	0.6	0.7	0.0	1.5	.
1-Undecene	7	87.5	0.9	8.3	3.4	3.7	2.5	1.0	1.1
n-Undecane	8	100.0	0.6	3.1	1.4	1.5	0.7	1.3	3.2
1-Dodecene	8	100.0	0.6	1.9	1.3	1.2	0.5	0.0	-1.4
n-Dodecane	8	100.0	0.6	8.5	1.6	2.4	2.6	2.3	5.7
1-Tridecene	5	62.5	0.4	1.4	0.5	0.7	0.4	1.3	0.7
n-Tridecane	8	100.0	0.6	3.1	1.3	1.5	0.9	0.9	-0.1

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-13

1993 Summary Statistics for Newark, New Jersey (NWNJ)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	8	100.0	7.7	49.1	19.9	20.6	12.9	1.7	3.9
Acetylene	8	.100.0	2.4	25.5	7.6	8.5	7.6	1.9	4.2
Ethane	8	100.0	8.4	53.8	17.3	19.9	14.6	2.2	5.3
Propyne	0	0.0	.[b]	.	.	.	.	.	.
Isobutane	8	100.0	2.5	24.1	6.6	9.3	7.7	1.2	0.6
1-Butene	8	100.0	1.4	9.1	3.4	4.0	2.8	0.9	-0.3
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	8	100.0	3.6	31.7	9.2	10.8	9.3	1.9	4.2
1,3-Butadiene	4	50.0	0.7	2.0	1.2	1.3	0.5	1.1	2.0
n-Butane	8	100.0	3.4	39.2	9.2	14.5	13.8	1.2	-0.0
Propane	8	100.0	6.0	64.4	18.0	24.0	20.9	1.3	0.8
t-2-Butene	8	100.0	0.4	3.7	1.1	1.7	1.2	1.2	-0.1
c-2-Butene	6	75.0	0.5	2.9	1.0	1.4	1.0	0.8	-1.6
3-Methyl-1-butene	6	75.0	0.4	1.9	1.0	1.2	0.7	0.2	-2.4
Isopentane	8	100.0	5.7	70.1	19.1	27.5	25.1	1.1	-0.4
1-Pentene	5	62.5	0.5	4.8	1.0	1.8	1.7	1.8	3.4
2-Methyl-1-butene	7	87.5	0.4	4.0	1.3	1.9	1.3	0.8	-0.9
n-Pentane	8	100.0	2.2	23.6	6.1	9.8	9.1	1.0	-0.8
Isoprene	7	87.5	0.7	3.1	1.3	1.6	0.9	1.1	0.1
t-2-Pentene	7	87.5	0.6	9.5	1.4	2.8	3.2	2.1	4.7
c-2-Pentene	5	62.5	0.6	3.0	1.3	1.7	1.0	0.5	-2.2
2-Methyl-2-butene	8	100.0	0.5	4.8	1.3	1.8	1.4	1.7	3.0
2,2-Dimethylbutane	6	75.0	0.4	1.4	0.6	0.7	0.4	1.8	3.6
Cyclopentene	1	12.5	0.8	0.8	0.8	0.8	.	.	.
4-Methyl-1-pentene	7	87.5	0.4	1.5	0.9	1.0	0.4	0.0	-0.4
Cyclopentane	6	75.0	0.5	6.9	1.3	2.1	2.4	2.2	5.0
2,3-Dimethylbutane	7	87.5	0.9	4.0	2.2	2.3	1.0	0.4	0.2

Table 9-13

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	8	100.0	1.4	17.8	3.9	5.8	5.5	1.8	3.2
3-Methylpentane	8	100.0	0.6	11.7	5.6	6.0	4.2	0.2	-1.2
2-Methyl-1-pentene	0	0.0	.	.	.	.	.	.	.
1-Hexene	4	50.0	0.6	1.4	0.7	0.8	0.4	1.9	3.6
2-Ethyl-1-butene	0	0.0	.	.	.	.	.	.	.
n-Hexane	8	100.0	1.0	10.2	3.2	4.2	3.3	1.0	-0.2
t-2-Hexene	5	62.5	0.5	1.0	0.7	0.7	0.2	-0.0	-2.6
c-2-Hexene	2	25.0	0.6	0.8	0.7	0.7	0.1	.	.
Methylcyclopentane	8	100.0	0.9	7.2	2.3	2.8	2.2	1.3	1.4
2,4-Dimethylpentane	7	87.5	0.4	4.1	1.5	1.7	1.2	1.4	2.4
Benzene	8	100.0	2.6	19.3	7.0	7.9	5.4	1.4	2.4
Cyclohexane	8	100.0	1.5	5.8	3.5	3.4	1.5	0.3	-0.7
2,3-Dimethylpentane	5	62.5	0.4	2.8	1.0	1.2	0.9	1.8	3.4
2-Methylhexane	8	100.0	0.5	5.3	1.8	2.4	1.8	0.9	-0.7
3-Methylhexane	8	100.0	1.8	10.1	3.0	4.1	2.7	1.8	3.5
2,2,4-Trimethylpentane	8	100.0	2.2	16.0	5.2	6.2	4.6	1.5	2.4
n-Heptane	8	100.0	0.5	5.9	1.7	2.1	1.8	1.4	1.7
Methylcyclohexane	8	100.0	0.5	2.9	1.0	1.4	1.0	1.0	-0.8
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	6	75.0	0.5	2.3	1.1	1.2	0.6	1.0	1.3
2,3,4-Trimethylpentane	8	100.0	0.6	5.7	2.1	2.3	1.7	1.4	2.3
Toluene	8	100.0	11.6	87.5	28.9	33.3	24.4	1.8	3.9
2-Methylheptane	7	87.5	0.7	4.7	1.6	1.9	1.4	1.7	3.4
3-Methylheptane	8	100.0	0.5	4.2	1.3	1.5	1.2	1.9	4.4
1-Octene	4	50.0	0.6	1.2	0.8	0.8	0.3	0.6	-2.5
n-Octane	6	75.0	0.6	3.9	1.0	1.5	1.2	2.2	5.1
Ethylbenzene	8	100.0	1.5	17.6	4.3	5.5	5.1	2.4	6.1

Table 9-13

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	8	100.0	0.5	60.4	11.9	16.9	18.6	2.2	5.6
Styrene	8	100.0	0.5	2.2	0.9	1.0	0.5	1.8	3.9
o-Xylene	8	100.0	1.8	18.7	5.0	6.0	5.4	2.2	5.5
1-Nonene	1	12.5	0.8	0.8	0.8	0.8	.	.	.
n-Nonane	8	100.0	0.9	5.8	1.4	2.0	1.6	2.5	6.5
Isopropylbenzene	3	37.5	1.1	1.3	1.2	1.2	0.1	1.1	.
alpha-Pinene	8	100.0	0.9	3.0	1.9	1.9	0.8	-0.1	-1.2
n-Propylbenzene	6	75.0	0.6	4.0	1.4	1.7	1.2	1.9	4.4
m-Ethyltoluene	8	100.0	1.3	9.8	3.1	3.5	2.8	1.9	4.4
p-Ethyltoluene	6	75.0	0.7	3.2	1.1	1.4	0.9	2.1	4.8
1,3,5-Trimethylbenzene	8	100.0	0.5	4.1	1.4	1.7	1.2	1.4	2.1
o-Ethyltoluene	8	100.0	0.7	5.9	2.0	2.2	1.6	2.0	4.8
beta-Pinene	3	37.5	0.5	2.3	0.5	1.1	1.0	1.7	.
1-Decene	8	100.0	0.7	1.4	0.9	1.0	0.3	0.9	-0.5
1,2,4-Trimethylbenzene	8	100.0	2.4	19.3	6.2	6.8	5.5	1.9	4.4
n-Decane	8	100.0	0.7	10.4	2.3	3.1	3.1	2.5	6.5
1,2,3-Trimethylbenzene	8	100.0	2.9	12.1	3.4	4.8	3.3	2.1	4.2
p-Diethylbenzene	7	87.5	0.5	1.5	0.5	0.9	0.5	0.4	-2.6
1-Undecene	7	87.5	1.2	2.6	1.7	1.7	0.5	0.6	-0.7
n-Undecane	8	100.0	1.3	8.5	2.5	3.4	2.4	1.7	2.5
1-Dodecene	8	100.0	0.7	2.0	0.9	1.0	0.4	1.8	3.2
n-Dodecane	8	100.0	0.5	26.4	2.0	4.8	8.8	2.8	7.8
1-Tridecene	3	37.5	0.5	1.2	0.9	0.8	0.3	-0.1	.
n-Tridecane	8	100.0	0.5	7.7	0.7	1.7	2.4	2.7	7.3

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-14

1993 Summary Statistics for Bristol, Pennsylvania (P1PA)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	8	100.0	5.3	25.5	11.2	13.2	7.7	0.6	-1.3
Acetylene	8	100.0	1.3	11.4	4.5	5.3	3.6	0.7	-0.7
Ethane	8	100.0	5.0	14.6	7.6	8.7	3.4	1.2	0.0
Propyne	0	0.0	[b]	.	.	.	.	.	.
Isobutane	8	100.0	2.3	13.4	5.5	6.3	4.0	0.8	-0.3
1-Butene	8	100.0	1.4	4.5	1.8	2.4	1.2	1.4	0.2
Isobutene	0	0.00	.	.	.	.	.	.	.
Propylene	8	100.0	1.9	9.2	5.1	5.3	3.0	0.1	-2.0
1,3-Butadiene	2	25.0	0.6	1.1	0.9	0.9	0.4	.	.
n-Butane	8	100.0	6.1	30.3	11.9	14.1	8.1	1.4	1.4
Propane	8	100.0	5.4	63.9	18.6	27.2	21.6	0.8	-0.9
t-2-Butene	5	62.5	0.8	2.2	0.9	1.3	0.6	1.4	1.1
c-2-Butene	3	37.5	0.7	0.9	0.7	0.8	0.2	1.7	.
3-Methyl-1-butene	4	50.0	0.4	1.9	0.8	1.0	0.7	1.4	2.5
Isopentane	8	100.0	11.5	48.9	17.1	22.0	12.5	1.8	3.0
1-Pentene	6	75.0	0.5	1.8	0.8	1.0	0.5	1.1	0.3
2-Methyl-1-butene	7	87.5	0.5	2.7	1.6	1.4	0.7	0.6	0.2
n-Pentane	8	100.0	5.0	17.2	8.8	9.4	4.1	1.0	1.0
Isoprene	7	87.5	1.3	6.1	4.0	3.6	1.7	-0.3	-0.6
t-2-Pentene	8	100.0	0.5	3.4	0.9	1.3	1.0	1.6	1.6
c-2-Pentene	5	62.5	0.5	3.2	1.5	1.7	1.3	0.3	-2.9
2-Methyl-2-butene	8	100.0	0.6	3.9	1.2	1.6	1.2	1.4	0.5
2,2-Dimethylbutane	4	50.0	1.2	20.1	16.8	13.7	8.5	-1.8	3.4
Cyclopentene	1	12.5	0.7	0.7	0.7	0.7	.	.	.
4-Methyl-1-pentene	7	87.5	0.6	1.4	0.8	0.9	0.3	0.6	-1.6
Cyclopentane	8	100.0	0.6	1.8	1.1	1.1	0.5	0.5	-1.0
2,3-Dimethylbutane	8	100.0	1.1	4.7	2.5	2.6	1.4	0.4	-1.5

Table 9-14

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	8	100.0	3.3	16.6	5.2	6.7	4.4	2.0	4.2
3-Methylpentane	8	100.0	2.4	2532.8	6.1	321.9	893.3	2.8	8.0
2-Methyl-1-pentene	0	0.0	.	.	.	.	.	.	.
1-Hexene	3	37.5	1.1	1.6	1.5	1.4	0.2	-1.6	.
2-Ethyl-1-butene	1	12.5	0.6	0.6	0.6	0.6	.	.	.
n-Hexane	8	100.0	2.0	16.8	3.8	5.6	4.9	2.0	4.5
t-2-Hexene	3	37.5	0.7	1.2	0.9	0.9	0.2	0.1	.
c-2-Hexene	1	12.5	0.6	0.6	0.6	0.6	.	.	.
Methylcyclopentane	8	100.0	1.0	161.5	2.3	22.5	56.2	2.8	8.0
2,4-Dimethylpentane	7	87.5	0.6	2.5	0.9	1.3	0.7	1.0	-0.2
Benzene	8	100.0	3.5	12.8	6.3	7.0	3.2	1.0	0.3
Cyclohexane	8	100.0	0.6	4.6	2.4	2.3	1.2	0.7	1.7
2,3-Dimethylpentane	1	12.5	0.7	0.7	0.7	0.7	.	.	.
2-Methylhexane	8	100.0	1.6	64.4	4.8	17.7	25.3	1.5	0.4
3-Methylhexane	8	100.0	1.7	57.7	4.2	15.9	22.6	1.5	0.5
2,2,4-Trimethylpentane	8	100.0	1.5	9.7	2.4	3.7	2.9	1.7	2.0
n-Heptane	8	100.0	1.0	28.2	3.5	8.3	10.0	1.6	1.2
Methylcyclohexane	7	87.5	1.5	6.6	2.2	3.0	1.8	1.6	2.2
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	7	87.5	0.5	1.6	0.8	0.9	0.4	0.6	-1.1
2,3,4-Trimethylpentane	8	100.0	0.7	3.5	1.1	1.5	1.0	1.5	1.4
Toluene	8	100.0	8.5	121.6	24.2	36.5	37.7	2.0	4.3
2-Methylheptane	8	100.0	0.8	4.2	1.6	1.8	1.1	1.6	2.9
3-Methylheptane	8	100.0	0.6	4.2	0.9	1.4	1.2	2.0	4.2
1-Octene	3	37.5	0.4	0.9	0.5	0.6	0.3	1.7	.
n-Octane	6	75.0	0.5	1.1	0.7	0.7	0.3	0.3	-2.2
Ethylbenzene	8	100.0	1.5	6.8	2.4	3.3	2.0	0.9	-0.7

Table 9-14

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	8	100.0	4.9	24.5	8.4	11.4	7.4	0.9	-0.6
Styrene	7	87.5	0.5	4.6	1.0	1.8	1.6	1.3	0.6
o-Xylene	8	100.0	1.6	22.5	3.7	6.3	7.0	2.2	5.0
1-Nonene	1	12.5	0.6	0.6	0.6	0.6	. .	.	.
n-Nonane	8	100.0	0.6	3.3	1.4	1.6	0.9	0.8	0.3
Isopropylbenzene	6	75.0	0.7	5.9	1.0	1.8	2.1	2.4	5.6
alpha-Pinene	8	100.0	0.5	2.5	1.6	1.7	0.7	-0.6	0.5
n-Propylbenzene	6	75.0	0.5	2.0	1.1	1.2	0.6	0.3	-2.0
m-Ethyltoluene	8	100.0	0.9	5.8	2.3	2.8	1.8	0.9	-0.4
p-Ethyltoluene	6	75.0	0.4	5.2	1.4	1.8	1.8	2.0	4.2
1,3,5-Trimethylbenzene	8	100.0	0.8	3.7	1.2	1.8	1.2	0.9	-1.0
o-Ethyltoluene	8	100.0	0.9	4.8	2.8	2.7	1.6	0.1	-1.7
beta-Pinene	6	75.0	0.4	4.6	1.0	1.5	1.6	2.2	5.1
1-Decene	8	100.0	0.6	1.7	1.1	1.2	0.4	0.2	-1.8
1,2,4-Trimethylbenzene	8	100.0	2.0	10.2	3.6	4.8	3.0	1.1	-0.2
n-Decane	7	87.5	0.7	11.6	2.6	4.3	4.4	1.1	-0.5
1,2,3-Trimethylbenzene	8	100.0	2.4	8.6	4.1	4.8	2.2	1.1	-0.0
p-Diethylbenzene	8	100.0	0.5	12.3	0.8	2.4	4.1	2.7	7.4
1-Undecene	8	100.0	0.9	3.9	2.4	2.4	1.1	-0.2	-1.4
n-Undecane	8	100.0	0.8	38.4	3.5	13.2	16.5	1.0	-0.9
1-Dodecene	8	100.0	0.9	2.9	1.3	1.5	0.7	1.9	3.5
n-Dodecane	8	100.0	0.7	22.1	2.9	8.9	9.6	0.6	-2.1
1-Tridecene	5	62.5	0.5	4.1	0.7	1.3	1.6	2.2	4.7
n-Tridecane	8	100.0	0.9	3.9	3.1	2.8	0.9	-1.4	2.7

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-15

1993 Summary Statistics for Harrisburg, Pennsylvania (P2PA)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	9	100.0	4.9	18.6	8.0	10.0	4.4	0.9	0.3
Acetylene	9	100.0	2.0	7.8	3.3	3.9	1.9	1.1	0.8
Ethane	9	100.0	6.5	13.0	9.2	9.6	2.3	0.4	-0.9
Propyne	0	0.0	b	.	.	.	.	.	.
Isobutane	9	100.0	2.1	7.3	5.0	5.0	2.0	-0.2	-1.4
1-Butene	9	100.0	1.2	2.7	2.1	1.9	0.5	0.0	-1.4
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	9	100.0	1.3	11.8	3.8	4.5	3.1	1.9	4.3
1,3-Butadiene	4	44.4	0.5	0.7	0.5	0.5	0.1	1.0	-0.6
n-Butane	9	100.0	3.4	13.7	9.3	8.6	3.5	-0.2	-1.3
Propane	9	100.0	6.9	50.0	12.9	17.6	13.0	2.3	6.0
t-2-Butene	3	33.3	0.5	1.7	0.8	1.0	0.6	1.3	.
c-2-Butene	5	55.6	0.5	1.6	1.4	1.1	0.5	-0.5	-2.8
3-Methyl-1-butene	4	44.4	0.6	0.8	0.7	0.7	0.1	-1.0	1.3
Isopentane	9	100.0	7.1	23.4	12.0	15.3	6.2	0.2	-2.0
1-Pentene	7	77.8	0.5	1.7	1.0	1.0	0.4	0.8	1.6
2-Methyl-1-butene	6	66.7	0.4	1.3	1.0	1.0	0.3	-0.6	-1.0
n-Pentane	9	100.0	3.6	9.0	5.0	5.9	2.1	0.3	-1.8
Isoprene	8	88.9	0.8	2.5	1.6	1.6	0.7	0.1	-2.0
t-2-Pentene	4	44.4	0.4	1.1	0.8	0.8	0.4	-0.2	-4.7
c-2-Pentene	4	44.4	0.7	1.4	1.0	1.0	0.3	0.3	-4.0
2-Methyl-2-butene	5	55.6	0.4	1.3	0.5	0.7	0.4	0.8	-1.9
2,2-Dimethylbutane	3	33.3	0.5	0.6	0.5	0.5	0.0	-0.5	.
Cyclopentene	1	11.1	0.4	0.4	0.4	0.4	.	.	.
4-Methyl-1-pentene	8	88.9	0.5	1.1	0.7	0.7	0.2	1.4	2.6
Cyclopentane	7	77.8	0.4	0.8	0.5	0.6	0.2	0.5	-2.0
2,3-Dimethylbutane	9	100.0	0.9	2.8	1.7	1.7	0.6	0.7	-0.3

Table 9-15

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	9	100.0	0.5	8.4	3.0	3.9	2.5	0.7	-0.5
3-Methylpentane	9	100.0	4.0	11.2	4.9	5.6	2.2	2.6	7.0
2-Methyl-1-pentene	2	22.2	0.7	2.1	1.4	1.4	1.0	.	.
1-Hexene	5	55.6	0.5	0.8	0.6	0.6	0.1	1.3	2.9
2-Ethyl-1-butene	0	0.0	.	.	.	.	.	.	.
n-Hexane	9	100.0	1.6	3.7	2.6	2.6	0.8	0.0	-1.5
t-2-Hexene	1	11.1	0.5	0.5	0.5	0.53	.	.	.
c-2-Hexene	0	0.0	.	.	.	.	.	.	.
Methylcyclopentane	9	100.0	1.2	2.8	1.5	1.9	0.7	0.4	-2.0
2,4-Dimethylpentane	9	100.0	0.4	1.1	0.8	0.8	0.2	0.2	-1.4
Benzene	9	100.0	2.9	7.7	5.4	5.3	1.4	-0.1	0.2
Cyclohexane	9	100.0	0.6	2.2	1.4	1.4	0.6	-0.2	-1.8
2,3-Dimethylpentane	1	11.1	0.7	0.7	0.7	0.7	.	.	.
2-Methylhexane	9	100.0	0.7	6.5	3.7	3.2	1.8	0.3	-0.3
3-Methylhexane	9	100.0	1.7	5.9	3.3	3.3	1.3	0.6	0.1
2,2,4-Trimethylpentane	9	100.0	1.6	4.6	2.7	3.0	1.2	0.3	-1.8
n-Heptane	9	100.0	0.4	4.0	1.7	2.1	1.2	0.4	-0.6
Methylcyclohexane	7	77.8	0.6	1.7	1.0	1.1	0.5	0.3	-2.0
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	8	88.9	0.4	1.4	0.6	0.7	0.3	1.8	4.1
2,3,4-Trimethylpentane	9	100.0	0.6	1.7	1.0	1.1	0.4	0.3	-1.8
Toluene	9	100.0	7.5	42.2	12.4	17.2	10.6	1.9	4.2
2-Methylheptane	9	100.0	0.5	3.2	1.0	1.1	0.8	2.5	6.8
3-Methylheptane	9	100.0	0.4	2.6	0.6	0.9	0.7	2.7	7.4
1-Octene	5	55.6	0.5	0.7	0.6	0.6	0.2	0.1	-1.1
n-Octane	7	77.8	0.4	1.6	0.5	0.7	0.4	2.4	5.9
Ethylbenzene	9	100.0	1.4	3.6	1.9	2.3	0.8	0.7	-0.8

Table 9-15

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	9	100.0	4.5	13.1	7.5	8.0	2.9	0.7	-0.4
Styrene	7	77.8	0.5	0.8	0.6	0.6	0.1	1.0	0.7
o-Xylene	9	100.0	1.4	4.2	2.3	2.6	1.0	0.5	-1.1
1-Nonene	5	55.6	0.7	1.3	1.1	1.0	0.3	-0.6	-0.7
n-Nonane	7	77.8	0.4	1.1	0.7	0.8	0.2	0.1	1.1
Isopropylbenzene	6	66.7	0.5	2.2	1.6	1.4	0.7	-0.4	-2.1
alpha-Pinene	9	100.0	0.6	2.9	1.9	1.7	0.9	0.2	-1.7
n-Propylbenzene	7	77.8	0.5	0.9	0.6	0.6	0.2	0.8	-0.9
m-Ethyltoluene	9	100.0	1.3	3.5	2.0	2.1	0.7	1.0	1.3
p-Ethyltoluene	6	66.7	0.6	0.9	0.7	0.7	0.1	0.5	-1.6
1,3,5-Trimethylbenzene	9	100.0	0.5	1.5	0.9	1.0	0.3	0.4	-0.6
o-Ethyltoluene	9	100.0	1.0	2.1	1.6	1.6	0.3	-0.6	1.3
beta-Pinene	7	77.8	0.5	1.9	0.8	1.0	0.6	0.6	-1.6
1-Decene	9	100.0	0.7	1.2	0.9	0.9	0.2	0.2	-1.1
1,2,4-Trimethylbenzene	9	100.0	1.7	4.7	3.0	3.1	1.1	0.2	-1.4
n-Decane	8	88.9	0.4	2.0	1.1	1.3	0.5	0.1	-0.9
1,2,3-Trimethylbenzene	9	100.0	2.4	23.9	3.1	5.6	6.9	2.9	8.7
p-Diethylbenzene	6	66.7	0.5	0.8	0.5	0.6	0.2	1.0	-0.9
1-Undecene	9	100.0	0.5	2.5	1.7	1.6	0.6	-0.4	-0.4
n-Undecane	9	100.0	0.7	2.1	1.5	1.5	0.4	-0.9	2.5
1-Dodecene	9	100.0	1.0	2.0	1.5	1.5	0.4	0.1	-1.6
n-Dodecane	9	100.0	1.0	4.2	1.1	1.6	1.1	2.5	6.1
1-Tridecene	8	88.9	0.4	0.6	0.5	0.5	0.1	-0.1	-0.9
n-Tridecane	9	100.0	0.7	2.2	0.9	1.1	0.6	1.3	0.3

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average;
Std Dev = Standard Deviation; S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

Table 9-16

1993 Summary Statistics for Plainfield, New Jersey (PLNJ)

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	8	100.0	4.2	84.8	23.1	35.3	31.8	0.7	-1.4
Acetylene	8	100.0	1.3	108.2	15.7	27.0	35.3	2.1	4.9
Ethane	8	100.0	6.3	92.3	17.5	37.1	35.7	0.8	-1.4
Propyne	0	0.0	.[b]	.	.	.	.	.	.
Isobutane	8	100.0	1.4	24.5	8.0	9.7	7.7	1.1	0.8
1-Butene	8	100.0	0.7	11.6	4.5	4.7	3.9	0.8	-0.4
Isobutene	0	0.0	.	.	.	.	.	.	.
Propylene	8	100.0	1.3	21.3	7.4	8.9	7.2	0.8	-0.4
1,3-Butadiene	5	62.5	0.6	2.2	1.0	1.2	0.6	1.3	1.4
n-Butane	8	100.0	1.8	37.4	12.8	13.8	11.1	1.5	2.9
Propane	8	100.0	2.2	85.6	19.7	24.2	26.0	2.3	6.0
t-2-Butene	6	75.0	0.6	5.7	2.2	2.9	2.1	0.5	-1.8
c-2-Butene	6	75.0	0.6	5.9	1.5	2.4	2.0	1.4	1.5
3-Methyl-1-butene	6	75.0	0.6	2.2	1.4	1.3	0.6	0.3	-0.2
Isopentane	8	100.0	4.6	102.4	23.7	31.9	31.7	1.8	3.9
1-Pentene	5	62.5	0.8	6.7	1.2	2.2	2.5	2.2	4.9
2-Methyl-1-butene	6	75.0	0.4	9.2	2.6	3.4	3.1	1.6	3.1
n-Pentane	8	100.0	1.2	46.4	10.4	12.9	14.5	2.2	5.2
Isoprene	8	100.0	1.1	7.3	4.0	3.7	2.1	0.3	-0.6
t-2-Pentene	6	75.0	0.8	11.3	3.2	4.2	3.8	1.6	2.9
c-2-Pentene	5	62.5	1.0	7.0	1.6	2.7	2.5	2.0	4.0
2-Methyl-2-butene	7	87.5	0.6	13.6	2.6	4.3	4.5	1.8	3.5
2,2-Dimethylbutane	5	62.5	0.6	1.6	1.0	1.1	0.3	0.5	1.4
Cyclopentene	3	37.5	0.5	2.6	1.2	1.4	1.1	1.0	.
4-Methyl-1-pentene	6	75.0	0.5	3.1	1.0	1.3	0.9	2.2	4.9
Cyclopentane	5	62.5	1.4	5.4	1.7	2.4	1.7	2.0	4.1
2,3-Dimethylbutane	8	100.0	1.0	9.2	2.9	3.3	2.7	1.6	2.8

Table 9-16

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
2-Methylpentane	8	100.0	1.0	39.1	8.6	11.7	12.5	1.7	3.4
3-Methylpentane	8	100.0	1.7	27.8	5.9	7.8	8.5	2.3	5.8
2-Methyl-1-pentene	4	50.0	0.7	4.7	1.3	2.0	1.8	1.8	3.0
1-Hexene	3	37.5	0.8	1.9	1.0	1.2	0.6	1.5	.
2-Ethyl-1-butene	1	12.5	0.6	0.6	0.6	0.6	.	.	.
n-Hexane	8	100.0	0.6	31.2	5.0	7.3	10.0	2.5	6.5
t-2-Hexene	4	50.0	0.5	5.4	1.4	2.2	2.2	1.7	3.2
c-2-Hexene	5	62.5	0.6	2.1	0.8	1.0	0.6	2.0	4.2
Methylcyclopentane	8	100.0	0.4	17.0	2.9	4.4	5.4	2.3	5.7
2,4-Dimethylpentane	7	87.5	0.7	6.2	1.7	2.2	1.9	2.0	4.6
Benzene	8	100.0	2.7	28.9	9.0	10.2	8.8	1.5	2.7
Cyclohexane	7	87.5	0.8	7.2	2.1	3.0	2.3	1.2	0.5
2,3-Dimethylpentane	4	50.0	0.7	1.3	1.1	1.1	0.2	-1.6	2.7
2-Methylhexane	7	87.5	0.8	17.6	1.3	4.4	6.1	2.2	4.9
3-Methylhexane	8	100.0	1.6	10.7	3.4	4.2	3.0	1.8	3.9
2,2,4-Trimethylpentane	8	100.0	0.5	23.1	6.9	7.6	7.2	1.6	3.1
n-Heptane	7	87.5	0.6	5.0	2.1	2.2	1.4	1.2	1.9
Methylcyclohexane	7	87.5	0.5	5.4	1.4	2.0	1.7	1.9	4.0
1-Heptene	0	0.0	.	.	.	.	.	.	.
2,2,3-Trimethylpentane	6	75.0	0.4	3.8	1.3	1.6	1.2	1.7	3.2
2,3,4-Trimethylpentane	8	100.0	0.5	9.1	2.5	3.1	2.8	1.5	2.7
Toluene	8	100.0	5.5	123.1	29.9	36.9	37.9	2.0	4.6
2-Methylheptane	6	75.0	0.6	5.5	2.1	2.4	1.7	1.6	3.3
3-Methylheptane	5	62.5	1.1	4.8	1.8	2.2	1.5	1.8	3.5
1-Octene	4	50.0	0.7	1.7	0.9	1.1	0.5	1.4	1.3
n-Octane	5	62.5	0.6	2.1	0.9	1.1	0.6	2.0	4.1
Ethylbenzene	8	100.0	0.8	14.9	3.9	4.9	4.6	1.7	3.3

Table 9-16

Continued

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
p-Xylene + m-Xylene	8	100.0	2.7	52.5	13.2	16.7	16.5	1.7	3.2
Styrene	6	75.0	0.9	2.8	1.2	1.4	0.7	2.2	5.1
o-Xylene	8	100.0	0.5	17.8	4.4	5.7	5.6	1.6	3.1
1-Nonene	1	12.5	0.6	0.6	0.6	0.6	.	.	.
n-Nonane	8	100.0	0.7	3.6	1.3	1.4	1.0	1.9	4.3
Isopropylbenzene	4	50.0	0.5	1.4	1.0	0.9	0.4	-0.0	-2.0
alpha-Pinene	7	87.5	0.7	2.9	1.4	1.5	0.8	0.8	0.0
n-Propylbenzene	6	75.0	0.8	4.1	1.6	1.9	1.2	1.5	2.5
m-Ethyltoluene	8	100.0	0.9	11.4	3.5	4.1	3.5	1.4	2.3
p-Ethyltoluene	5	62.5	1.0	3.1	1.5	1.7	0.9	1.6	2.6
1,3,5-Trimethylbenzene	6	75.0	0.5	5.3	2.5	2.6	1.6	0.6	0.9
o-Ethyltoluene	7	87.5	0.7	7.1	2.1	2.9	2.2	1.4	2.4
beta-Pinene	4	50.0	0.6	2.4	0.8	1.1	0.8	1.9	3.7
1-Decene	7	87.5	0.9	4.0	1.4	1.7	1.1	2.4	6.1
1,2,4-Trimethylbenzene	8	100.0	1.4	19.6	6.0	6.9	6.2	1.3	1.8
n-Decane	6	75.0	0.5	3.5	1.3	1.6	1.1	1.3	1.6
1,2,3-Trimethylbenzene	8	100.0	1.8	9.1	5.2	5.3	2.4	0.2	-0.7
p-Diethylbenzene	6	75.0	0.6	1.9	1.5	1.4	0.5	-0.7	-0.4
1-Undecene	6	75.0	0.8	13.1	1.7	3.5	4.8	2.3	5.5
n-Undecane	8	100.0	1.2	7.0	2.2	2.8	2.0	1.7	2.9
1-Dodecene	6	75.0	0.6	6.6	1.3	2.6	2.5	1.1	-0.9
n-Dodecane	8	100.0	0.5	14.9	1.1	3.0	4.9	2.6	7.2
1-Tridecene	4	50.0	0.7	1.2	1.0	1.0	0.2	-1.4	2.5
n-Tridecane	6	75.0	0.6	2.8	1.1	1.3	0.8	1.8	4.0

[a]Freq = Frequency; Min = Minimum; Max = Maximum; Med = Median; Avg = Average
Std Dev = Standard Deviation, S = Skewness; K = Kurtosis
[b]Calculation not possible due to limited data.

number given for standard deviation, skewness, and kurtosis are the second, third, and fourth moments, respectively, about the arithmetic means. A skewness value greater than zero applies to distributions having a longer tail to the right, whereas a value less than zero applies to distributions having a longer tail to the left. A distribution that is normally distributed would have a kurtosis of 3.0. A distribution more peaked (or pointed) than a normal distribution, having the same variance, would have a kurtosis greater than 3.0, whereas a less peaked than a normal distribution, having the same variance, would have a kurtosis less than 3.0. All the kurtosis figures listed in this report are zero centered, which means that 3.0 has been subtracted from the fourth moment to give a reported kurtosis of 0.0 for a symmetrical distribution.

9.3   Overall Data Summary

Table 9-17 presents the overall summary statistics for all daily monitoring sites in the 1993 monitoring program. The analysis results of 624 samples were considered for these statistics. Duplicate and duplicate/replicate data for a given sample date were averaged and considered as one sample. Average concentrations ranged from 0.72 ppbC for c-2-hexene to 29.85 ppbC for propane. The largest standard deviation of concentration, 73.99 ppbC, was observed for isopentane.

Table 9-18 contains overall summary statistics for all optional analysis sites in the 1993 monitoring program. A total of 41 samples were considered, and statistics are reported in the same manner as the daily monitoring summary statistics. Average concentrations ranged from 0.61 ppbC for 2-ethyl-1-butene to 2532.80 ppbC for 3-methylpentane. The largest standard deviation was 394.68 ppbC for 3-methylpentane.

9.4   Individual Sample Results

Appendix K contains the results from individual sample analyses. For each site sample, all target compounds are listed along with the concentration reported for each sample. There is also an unidentified compound sum concentration reported for each

Table 9-17

1993 Summary Statistics for All Program Sites

Compound	Cases	Freq[a] (%)	ppbC						
			Min[a]	Max[a]	Med[a]	Avg[a]	Std Dev[a]	S[a]	K[a]
Ethylene	611	97.9	0.6	146.0	10.0	14.7	17.1	4.1	22.9
Acetylene	607	97.3	0.6	60.1	5.7	8.4	7.7	2.0	5.9
Ethane	614	98.4	0.6	82.6	8.8	12.6	11.5	2.4	7.9
Propyne	0	0.00	.[b]		.	.	.	.	.
Isobutane	578	92.6	0.5	215.3	3.7	7.4	14.9	8.2	90.3
1-Butene	587	94.1	0.5	38.4	1.9	2.6	2.5	6.7	77.6
Isobutene	1	0.2	1.8	1.8	1.8	1.8	.	.	.
Propylene	616	98.7	0.6	64.4	3.4	5.1	5.5	4.3	29.8
1,3-Butadiene	213	34.1	0.4	3.7	0.9	1.1	0.6	1.5	2.7
n-Butane	617	98.9	0.8	502.4	7.8	14.2	27.6	11.1	172.6
Propane	623	99.8	1.4	532.6	13.3	29.9	60.0	5.8	38.7
t-2-Butene	275	44.1	0.4	32.5	1.2	1.6	2.4	9.9	118.3
c-2-Butene	255	40.9	0.4	24.4	1.0	1.4	2.1	8.5	84.6
3-Methyl-1-butene	218	34.9	0.4	10.9	0.9	1.2	1.1	5.3	39.9
Isopentane	622	99.7	1.0	875.8	14.2	29.2	74.0	8.7	86.2
1-Pentene	408	65.4	0.4	23.0	1.0	1.6	2.2	5.8	41.4
2-Methyl-1-butene	444	71.2	0.4	32.7	1.2	1.7	2.1	9.2	119.4
n-Pentane	623	99.8	0.5	436.1	6.4	11.5	24.0	11.9	183.8
Isoprene	537	86.1	0.4	27.9	1.8	3.1	3.5	2.9	11.4
t-2-Pentene	499	80.0	0.4	28.0	1.4	2.0	2.1	6.1	58.3
c-2-Pentene	354	56.7	0.4	15.2	1.0	1.4	1.3	5.6	48.0
2-Methyl-2-butene	547	87.7	0.4	40.6	1.5	2.3	2.9	7.7	85.4
2,2-Dimethylbutane	610	97.8	0.4	85.5	6.7	8.4	8.4	4.1	23.6
Cyclopentene	189	30.3	0.4	4.3	0.7	0.8	0.5	3.8	21.1
4-Methyl-1-pentene	323	51.8	0.4	3.5	0.9	1.0	0.5	1.7	3.5
Cyclopentane	391	62.7	0.4	29.7	1.1	1.7	2.7	6.9	57.3
2,3-Dimethylbutane	557	89.3	0.4	31.2	1.6	2.2	2.2	5.9	60.2